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The AUTOMOBILE

Vol. XXXIV
No. 19

NEW YORK, MAY 11, 1916

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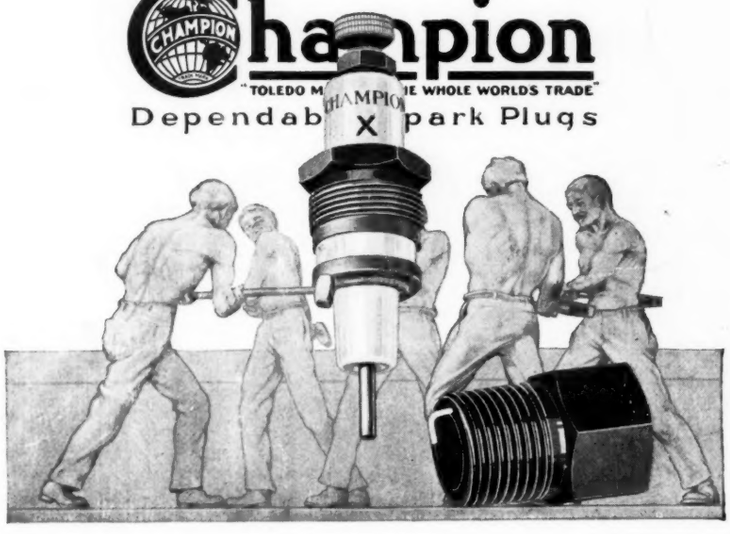

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VOL. XXXIV NEW YORK—THURSDAY, MAY 11, 1916—CHICAGO NO. 19

The AUTOMOBILE

Improving Splash Oiling

Dipper Lubrication Systems Could Be Much Improved—Some Conventional Designs Highly Inefficient—Effect of Load and Gradient Analyzed

By L. V. Spencer

VERY many of the splash lubrication systems found in present-day automobile engines are capable of much improvement. They work well on the level, as a rule, but let the car get on a grade, even as low as 10 per cent, and most of them are so constructed that less than the required amount of oil is splashed as it should be. This refers particularly to the splash system, but some of the pressure type and the combined pressure and splash systems can also be criticised in this respect.

It almost seems that engine and car designers have been so deeply concerned in the development of good-looking, silent-running and generally efficient cars that they have had very little time or inclination to attack the engine oiling, since in the average case it is sufficiently good. Yet surely the lubrication of the motor is one of the first things that should be worked out satisfactorily. So much of the efficient operation and general satisfaction that is derived from a car depends upon the oiling system that it would seem the engineering fraternity has sidetracked a very important step in car development in its haste to attack those things that are more evident on the surface.

The foregoing applies most strongly to the low or medium priced car; the higher priced types are generally better because of more careful designing for a more exacting clientele. The really absurd part of it is that the cost of such improvements as would make the average engine greatly better, so far as lubrication under general operation conditions is concerned, is small indeed, and the wonder is that these designers persist in the use of systems that are fundamentally wrong when the cost of alteration is so greatly out of proportion to the benefits to be derived from simply rectifying these conditions.

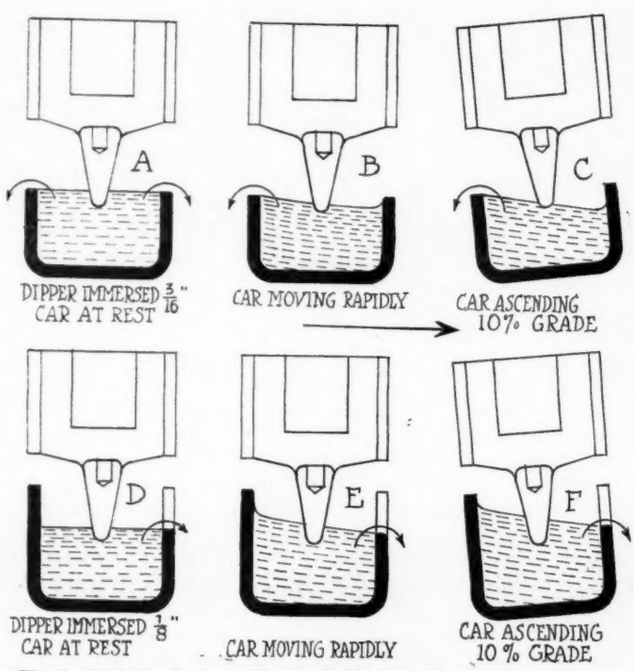


Fig. 1—A, B, C—Action with equal sided trough. D, E, F—Action with overflow trough. A—Dipper immersed 3/16 in., car at rest. B—Car accelerating. C—Car ascending 10 per cent grade. D—Dipper immersed 1/8 in., car at rest. E—Car accelerating. F—Car ascending 10 per cent grade

Probably a great many engineers will not agree with the stand that has been taken and will maintain that the normal schemes for getting an equal amount of oil to each cylinder and bearing are practically sound. It is not with the intention of attacking any system specifically, but with the thought of showing the faults in many of the well-known arrangements that this article has been prepared. Often a very small modification will make a wonderful difference in the working of a system, and it is hoped that such criticism as follows will be productive of some good results generally. The diagrams have been taken from the actual drawings of certain representative designs.

Our attention will first be directed to some of the flagrant violations of good practice that are to be found in certain widely used types of splash systems. The full

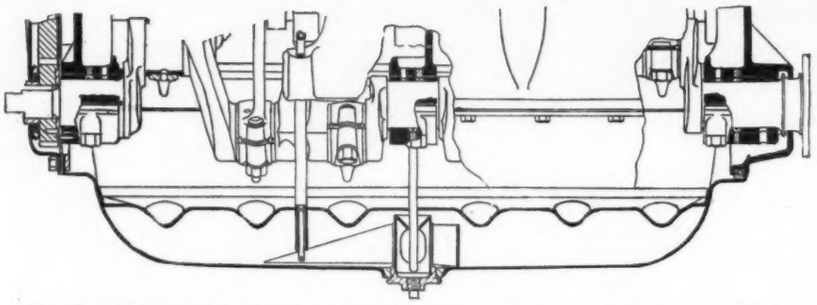


Fig. 2—Section of oil trough construction in common use. There is no provision for retaining sufficient oil in the splash troughs for hill work. The front troughs are starved on up-hill going and get too much oil on down grade

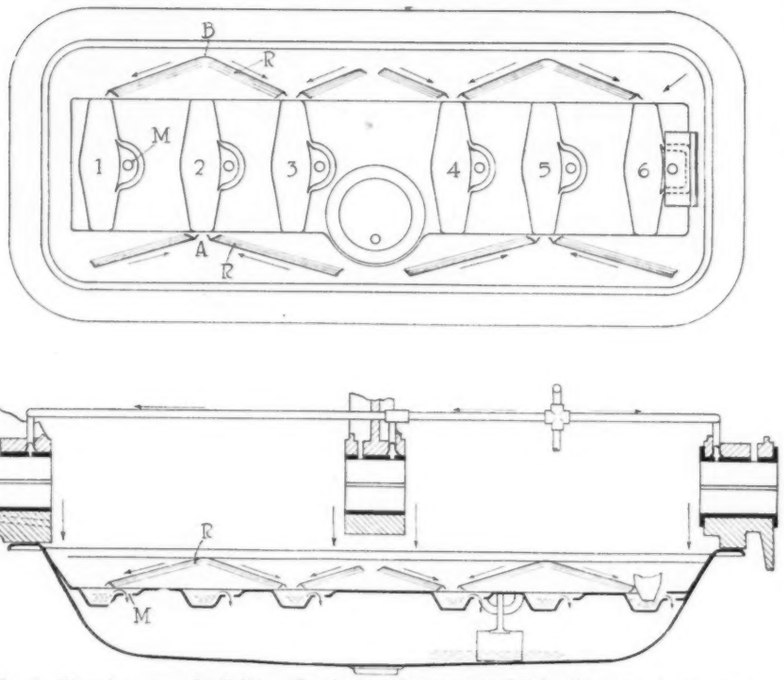


Fig. 3—Showing an adaptation of return ridges pressed into the trough to redistribute the splashed oil evenly

advantage of the fact that gravity is the big factor in the handling of the oil in such systems is very evidently often overlooked. Take for example the conventional form of splash trough that you will find in at least two-thirds of the engines using splash. This is shown in Fig. 1, and it will be noticed that the two sides are on the same level, with overflow either way. Now suppose the engine with this trough to be inclined as in ascending a 10 per cent grade, as at *C*. The oil backs away from the front side of the trough and flows out at the rear, thus lowering the working level, and reducing the possible dip of the splasher on the end of the connecting-rod. Obviously, as the grade increases, less and less oil can be dipped by the splasher. Yet on steep grades it is especially desirable that more oil be sent to the cylinder walls and bearing surfaces. Thus the action is exactly the opposite from what it should be.

Several Simple Remedies

There are several simple remedies for this defective trough construction. Would it not be possible to raise the rear side of the trough about ¼ to ⅜ in. to prevent the oil from flowing out this way when on a grade, and of such a height that the dipper would get a maximum at about 20 per cent grade? Such a suggested construction is shown at *D*. As the grade increases, the more the liquid is backed up on the rear side, and hence the greater the depth the dipper enters, and the more oil is splashed, which is as it should be. Obviously if both sides were made of this greater height without some provision for lowering the level when on flat ground, the dipper would dip too deeply and an excess of the requirements would be supplied. But to prevent this, and to bring the level to just what is needed for flat ground, an overflow can be cut in the front side of the trough to reduce the level to the minimum. The action is clearly brought out in the diagrams which compare this simple modification with the conventional trough. A similar trough arrangement has been noted in several motors.

This is but one illustration of the point that it is hoped to bring out—that a little ingenuity will do great things for motor oiling, and with a minimum of expense.

Take another instance of an inefficient arrangement that could be very readily improved so as to work most advantageously under practically all operative conditions. This is the typical splash trough and connecting oil pan of a well-known motor.

When Going Up Hill

Referring to Fig. 2, it will be noted that the troughs under the connecting-rods are pressed into the sub-base and there is no special provision to compensate for running on hills. Suppose the car to be going up a hill. Then the front end of the oil pan is elevated, and there is a tendency for the oil to run out of the front troughs, starving the forward cylinders and giving too much to the rear ones. If the grade is not steep enough for much of the oil to run out of the troughs, it will at least act as already shown by the diagrams in Fig. 1. On descending a hill the result is the opposite and the front cylinders get more than their share of the oil.

The writer believes that some sort of overflow device would greatly relieve this undesirable condition without very materially affecting the cost of construction. If a slot were cut in the forward side of each of these troughs at the proper height and the rear side were pressed out a little higher than it is normally in Fig. 2, this would have the effect of drawing off the oil through the overflow slots when the car is on a down grade, preventing excess from working its way back to the rear cylinders. While it is true that such lowering of the level in the troughs would prevent a normal amount from being splashed, it must be remembered that it is not necessary to have as large a supply when going down grade. On ascending, the higher rear sides of the troughs would also prevent the oil from overflowing back to the rear cylinders, and the greater dip would result in more oil being splashed to the bearing surfaces—a desirable feature for up-grade work. There are, doubtless, many variations of this idea and, while a number of cases have been observed where some such principle is involved, the number of splash installations in which the troughs make no provision for any angular positions of the engine is surprising.

It is doubtful if this modification of the simple trough would alone effect the most satisfactory results, although there is no question of its value. It could very cheaply be made in conjunction with little ridges or channels that might be pressed into the sub-base to direct the oil running down from the cylinders or other points, on which this oil had landed after being thrown up by the rod ends. Such ridges

would serve to distribute the returning oil, and prevent one trough from getting an over-abundance.

Recently a very neat adaptation of this idea was observed in a certain design, somewhat similar to the diagram reproduced in Fig. 3. Diagonal ridges *R* were raised in the pan as indicated, and led to the different troughs in such a way that each was calculated to be cared for properly. By this arrangement, oil that finds its way to point *B* for instance, would be directed either to trough No. 1 or to No. 3, whereas directly opposite to point *B*. Such distribution is quite autoany that arrived at *A* flows into trough No. 2, although directly opposite to point *B*.

Incidentally the diagrams in Fig. 3 also show a scheme for taking care of the trough level by means of overflow ducts *M*, with the idea of compensating for variations of motor angle. Such a combination involves patents held by E. M. White, Detroit, Mich.

Fig. 4 shows another arrangement of this kind that is entirely of the splash type, and is somewhat of a variation from the scheme of Fig. 3, although the principles are exactly the same so far as the dividing of the splashed lubricant and its return to the troughs is concerned. In addition, this indicates a good method of insuring clean oil getting to the main bearing through the lead *N* which is arranged so as to catch some of the splash and direct it to the bearing through a standpipe brought a slight amount above the level of the pocket in the bearing support. Any particles of metal or grit will settle in the pocket and only the clear oil flows through the pipe to the bearing. This is a refinement, which, though seemingly small in itself, has much to do with the efficient lubrication of these important points. It is a thing small in cost but, when added to other little refinements, aids materially in securing the most from the lubrication system.

Insuring Distribution

There are other methods of insuring distribution of the lubricant in splash systems, utilizing gulleys or ridges pressed into or cast in the side of the crankcase or stamping that forms the holder for the troughs. One patented way of doing this which indicates the possibilities of efficient lubrication with great simplicity is shown by the diagram in Fig. 5. In this case all the oil is introduced at the front, going either first to the timing gears and then to No. 1 trough, or to this trough direct. Excess over the amount required for this trough overflows through the hole at *D*, and on being splashed from this No. 1 reservoir, the lubricant is caught in the diagonal ridge *C* and led to the next trough. From this it is carried by the next diagonal to the next successive splash reservoir and on back until it eventually enters the end trough, the excess then overflowing through hole *E* into the reservoir.

The action is obviously one in which the minimum amount of oil is splashed when the engine is idling or the car is running very slowly, and increases with the speed of engine and car, for the speed of the car serves to back the oil away from the overflow holes somewhat, making a greater level for the rod ends to dip in the master troughs, thus increasing the splash to the others as well. As the engine speeds up the pump delivers an increasing quantity, which is reflected in the added amount the intermediate troughs get as well as the controlling ones at the ends.

The shape of dippers has a great deal to do with the splashing of the oil. If a narrow face meets the oil then the dip is not nearly so efficient as in the case where a wider dipper is used, which serves to scoop the oil, the effectiveness of the splash of course depending upon the needs, and the shape made accordingly. Some designs of engines are to be found in which no special dippers are fitted, but the ends of the cap bolts are relied upon to do the work, similar to Fig. 8. This is probably satisfactory when the engine occupies a level position, but if on a grade of even moderate steepness, the trough level is apt to slant so that such a narrow dipping surface barely touches the oil. To overcome this, some form of wider dipper is advisable—one that will get into the oil no matter what the angle. Fig. 6 will illustrate this point. The round dipper here shown, in connection with the round-bottomed trough, works equally well in getting into the oil on even very steep grades. The wider the dipper face, the less deeply it has to enter the trough, hence generally speaking, the dipper shape has a bearing upon the form and depth of the trough section. Simplicity of manufacture would seem to dictate a wide shallow trough with a wide-faced dipper. It looks like putting the cart before the horse to design the rod dipper and then think about a trough to fit it, but the dipper design should not be considered as an afterthought—anything that will be easiest to fit. It is

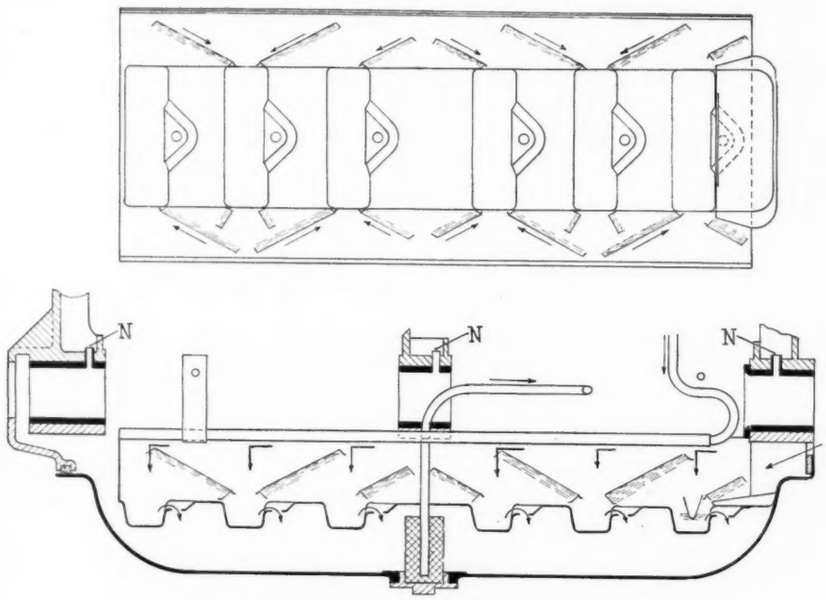


Fig. 4—Return splash trough and pan arrangement for a six

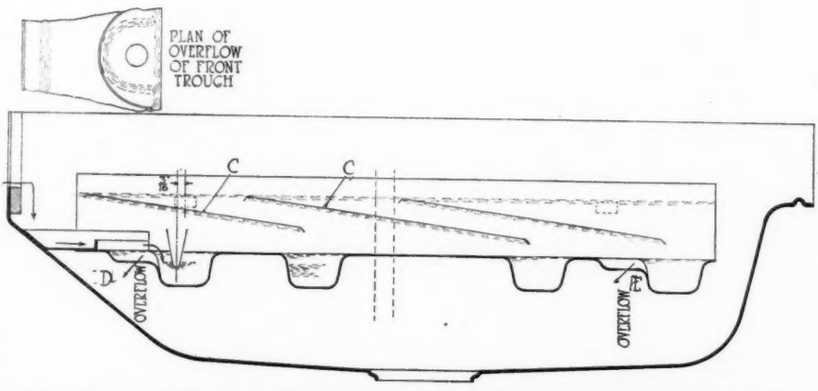


Fig. 5—A circulating splash arrangement which introduces all the oil at the front trough and eventually allows it to overflow at the rear trough

as important to general results as any other feature. A deep trough is not required provided the circulation of the oil is in conformity with the rapidity with which the oil in the trough is depleted, and there is provision for maintenance of level for various motor angles.

In some splash systems, the troughs do not follow the circumference of the crank circles far enough to maintain oil in the troughs at the various angles to which the engine is sometimes tipped sideways. While this is not so important a consideration as that of proper care for uphill and down-grade operation, nevertheless there are times when the road slopes to one side to cause even as much as a 15 deg. angle from the horizontal, and this should be taken into account in designing a system that will be adequate for any conditions that might be met in service. It is not much trouble to curve the troughs up at the sides so as to retain oil under such conditions, and no trough that is nearly straight can hope to act efficiently when the engine is tipped sideways to any extent. Fig. 7 illustrates a trough designed to take care of this condition. Note that the trough follows the crank circle sufficiently on either side to hold plenty of oil at even extreme side angular positions of the crankcase.

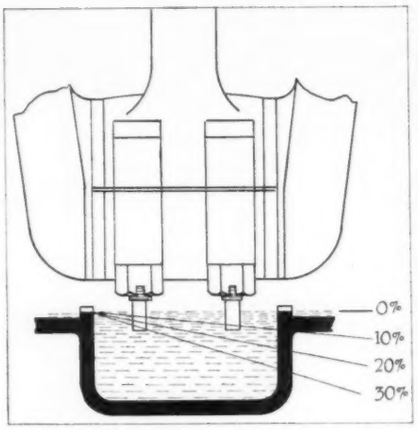


Fig. 8—Illustrating the ineffectiveness of dippers of the form shown when on grades of carrying amount

Two Important Factors

In one respect the engineer's task is very hard, for there are two things to keep in mind: the bearings need all the oil that can be supplied to them, and the details of dipper and trough design so far considered have been regarded from this viewpoint. On the other hand, the pistons must not receive too much, or else the oil will get to the combustion space in quantities, producing smoke and rapid carbonization. The reason that such extremely narrow dippers are used on some high-speed engines with splash lubrication is that any increase in width floods the cylinders at once.

Must Not Impair Bearing Supply

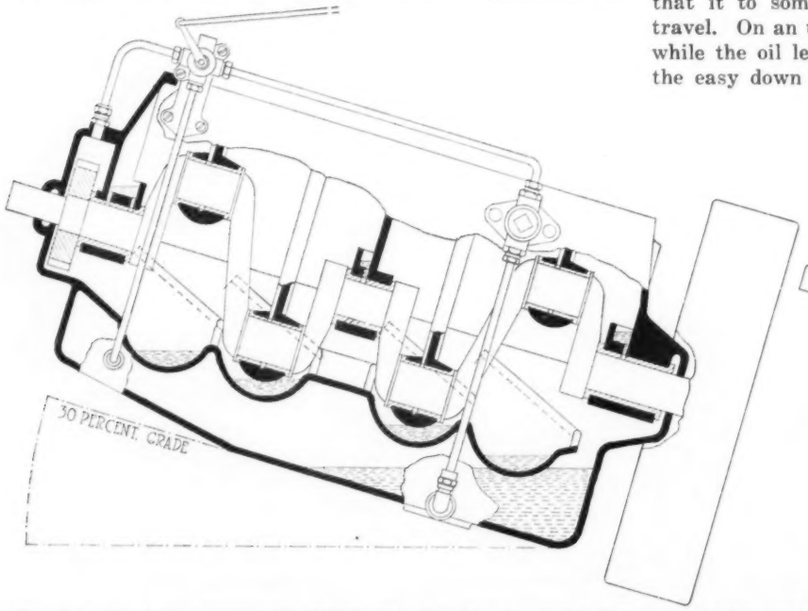
It seems, however, that it is fundamentally wrong to cut down the bearing supply in order to prevent too much reaching the cylinder walls. It is not difficult to design pistons to resist the passage of the tremendous whirl of oil thrown out from the bearings of a full force lubricated motor, baffles to deflect the spray and a proper piston design being able to cope with almost any oiling conditions.

First, a long piston is a great help, and luckily aluminum alloy has made long pistons possible without substantial increase in the reciprocating weight. Grooves in the piston with small holes leading to the inside of the skirt are another effective method. A few large holes drilled in the skirt is another solution, much favored in European high-speed engine design, while there are all sorts of alternative designs for scraper rings.

Another point in lubrication which has been much neglected, is means for varying the oil supply to suit the amount of work the engine is doing rather than to suit its speed. Examples of this idea are seen in the Marmon and the Rolls-Royce designs, where the oil is throttled by a cock in connection with the carbureter throttle. Both these systems are full pressure ones, but the idea has been applied to splash oiling, notably by Chas. Y. Knight, the neatest example being seen in the Minerva-Knight engine.

In this design each trough is a separate piece. Seen from the front of the motor the edges of the trough are curved as in Fig. 7, to maintain the level when the trough is tilted, but instead of being fixed to the crankcase base, each trough is hinged at one end to the crankcase side. On the opposite side of the crankcase there is a rod running from end to end having a series of small arms projecting inward and links from the ends of these arms support the free ends of the troughs. The extreme end of the rod passes through the crankcase and a final lever is here linked to the throttle control. On opening the throttle the rod is turned so as to lift the troughs, so increasing the depth of dip of the connecting-rod splashers. As the throttle is closed the troughs are lowered again so that the dippers only just lick the surface at idling speed, this arrangement giving sufficient distribution under these conditions.

This device, though complicated, has a double advantage in that it to some extent compensates for up and down hill travel. On an up grade the throttle is open and the dip deep, while the oil level drops with the closing of the throttle for the easy down hill run.



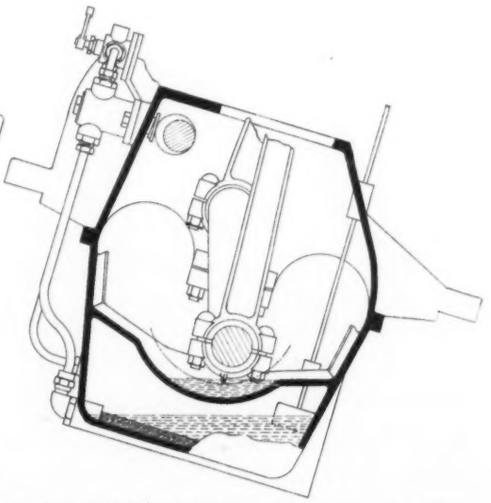


Fig. 6—Left—How a round flat dipper gets into the oil equally well at all angles up to the limitations of the engine. Fig. 7—Right—Trough rounded to care for condition when engine is tipped considerably to one side

Extraordinary Transmission System

Danish Design Eliminates Rear Axle—Rear Wheels Can Move Independently

By A. Ludlow Clayden

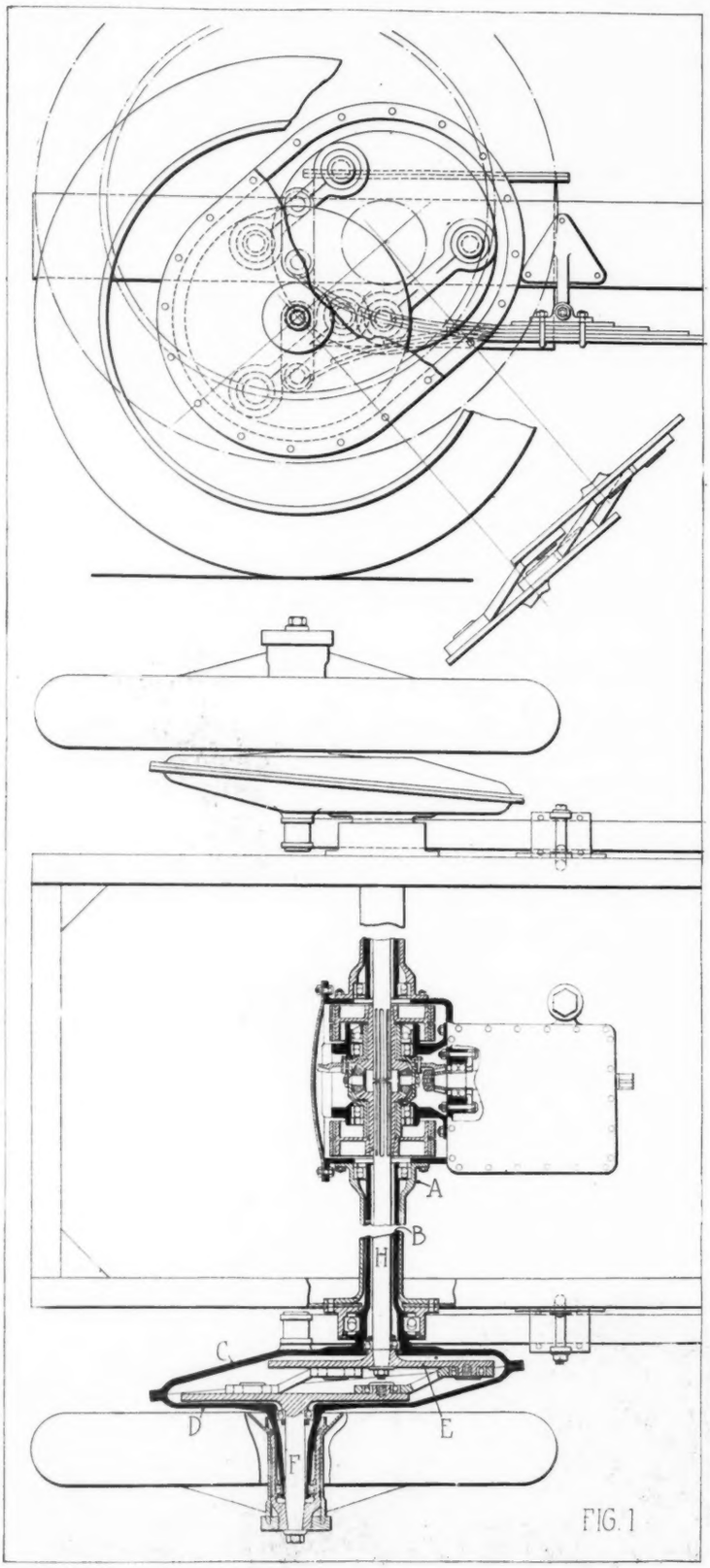


Fig. 1—Jacobson transmission in part section showing the method for supporting the wheels without an axle, and the connecting rod drive. Observe the location of the two brakes on either side of the differential

IT is but rarely that a practicable automobile invention appears that is utterly new and has little reference to anything that has gone before. The idea illustrated on this page, the invention of P. Jacobson, Jyderup, Denmark, appears to possess this sort of novelty and is highly interesting, even though it must remain for trial to demonstrate the validity of the claims.

The inventor states as his chief aim the reduction of unsprung weight, and his design provides for very little more of this than the weight of the wheel itself. There is no rear axle in the accepted sense of the word, and the two rear wheels are quite independent of each other. With an axle connecting two wheels the passage of one wheel over a high spot causes compression of the spring on one side and so tilts the axle and both wheels relatively to the body of the car. The Jacobson transmission, on the other hand, arrests all tilting and allows either rear wheel to lift in a truly vertical plane.

No Rear Axle

The device is shown in section in Fig. 1. Attached rigidly to the frame of the chassis is a differential housing which may easily be combined with the gearset. The differential is driven by bevel gear in the usual way and operates two ordinary driveshafts, the casing being supported by the outer tubes *A*. Leaving the question of drive for a moment, the method for supporting the wheels may be explained. Between the casing *A* and the drive shaft is a tube *B* mounted in ball bearings at either end and free to revolve without affecting either the casing *A* or the driveshaft. To the outer end of this is fixed a steel forging *C*, which is shaped to a kind of oval, something like a short chain case, and there is a cover plate of steel *D* which has a tubular projection on which the road wheel bearings are mounted. On the back of the case *C* there is a pin, in line with the wheel center, and to this pin the end of the cantilever spring is fitted. Thus the effect is the same as if the wheel were attached directly, and individually, to the end of the spring, lateral stability being given by the case *C* and the tube *B*. The three parts, *B*, *C* and *D* together form a piece which may be likened to one-half of a floating axle with a crank in it near the outer end.

By these means the inventor has provided a system for supporting the two wheels independently so that a rise or fall of one wheel has no effect whatever upon the other. The next step is to provide means for driving both wheels through the medium of the centrally placed differential.

To do this a circular plate *E* is attached to the end of each driveshaft and an exactly similar plate

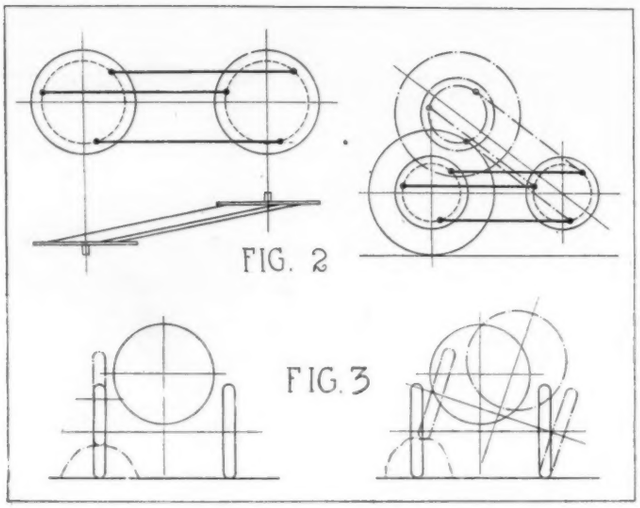


Fig. 2—Diagram showing that the velocity ratio of the driveshafts is unaffected by spring action
Fig. 3—Contrasting the tilting action of a road shock on the ordinary axle, and the vertical movement of the wheel in the Jacobson design

is forged with a short driveshaft *F* connected to the road wheel just like the driveshaft of a floating axle. To transmit the drive from *E* to *F* there are three short connecting rods, arranged as shown in diagrammatic form in Fig. 2. These rods are mounted on ball bearings at either end and are quite short, about 8 in. between centers being the inventor's suggestion.

This brings us to an important stage in the idea, namely that the drive velocity ratio is unaffected by movement of the spring. Let us suppose that a gear drive had been used instead of the connecting rods. Had this been so, then moving the wheel up and down would cause relative rotative motion between the main driveshaft *H* and the final driveshaft *F*. In other words, passing over a bump would cause the speed of rotation of the road wheel to vary as the spring was compressed by reason of the movement of the center of *F* around the center of *H*. Imagine a gear on the end of *H* held stationary meshing with a pinion on *F*, and it is obvious that *F* could not be lifted upward without causing the pinion to turn.

With the connecting rods this does not happen because each rod is free at each end. The simplest explanation is that given in the diagram, Fig. 3, which shows that the driveshafts are not affected by spring action.

The inventor sums up his claims as follows:

"No small advantages are claimed for the mechanism described compared with orthodox design. No rear axle is needed which has to be strong enough to carry the weight of the car under shocks. All parts may be of light weight; the heaviest, the steel-cover, has but small dimensions. The remaining parts of the transmission may be inclosed in light covers, as they are not influenced by very strong forces and can be braced by rigid girder constructions.

"Springing will be much improved, the wheels move in an ideal manner, causing the car to be light on tires and sideway rolling is absent, making for better stability on the road. The lubrication may be easily made perfectly automatic, as all the transmission forms a unit. By two lengths of tubing the lubrication of the transmission system may be connected to the lubricating system of the engine.

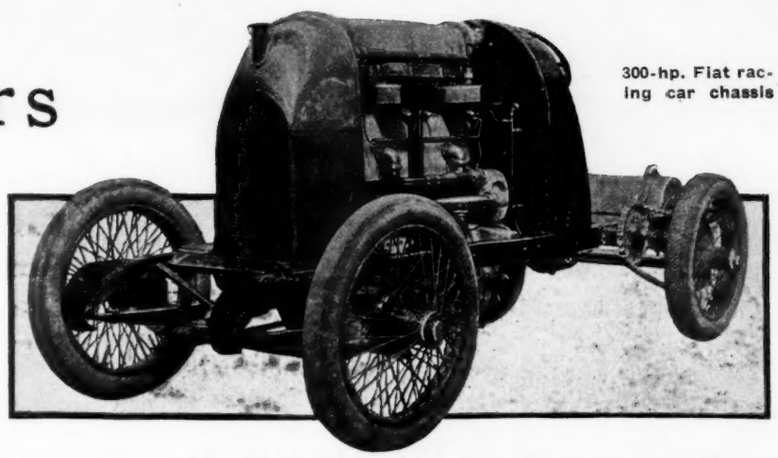
"Yet this novel proposition gets its greatest importance from its perfectly even transmission of power from the engine to the wheels, unaffected by the condition of the road. Combined with the perfect springing this provides a comfort hitherto undreamed of."

Mulford's Driving a Factor in Hudson 24-Hour Record

LAST week THE AUTOMOBILE published in conjunction with its account of the 24-hr. record made by the Hudson Super Six at the Sheepshead Bay Motor Speedway an illustration showing Ralph Mulford at the wheel of the car ready to start on his round-the-clock run. This week our readers may get an idea of the conditions under which part of the trial was made from the accompanying illustrations, that at the top of the group showing the car during one of its brief stops for supplies some time in the watches of the night. Below at the left, is Mulford as he appeared before starting his trial for the world's record and at the right his somewhat tired but still cheerful countenance after the task was accomplished. In spite of the nerve-racking grind at racing speed, however, Mulford's stamina and recuperative powers are shown by the fact that at eight o'clock the following morning he was tearing around the speedway again in the Peugeot he will drive in the May 13 races.

Hudson Super Six stopping for supplies on its world's record 24-hr. run. Below, left, Mulford at the start; right, after the run was finished

Monster Cars Hold Few Records



300-hp. Fiat racing car chassis

THE world's biggest and fastest automobile will always be attractive to the motorist, no matter what his personal views may be on practicability and economy. Fiat holds the record for both size and speed with a 300-hp. car which was driven by Duray at Ostend, Belgium, at a speed of 142.9 m.p.h. This racing freak has a four-cylinder motor of 7.48 by 10.4 in. bore and stroke, giving a piston displacement of 1828 cu. in. The car was built to the order of a Russian prince, and was first driven by Nazzaro. The ambition of the prince was to break the world's straightaway record, and with this object in view he sent Arthur Duray and the car to Ostend in November, 1913. The Italian car was officially timed on several occasions to cover the kilometer at a fraction more than 142 m.p.h. But in order to satisfy the European regulations the run had to be made out and home within a quarter of an hour. Owing to variable weather conditions—wind from the sea, sand blowing in from the shore, rain, etc.—Duray could never make the two trips within the time allowance. Thus, although his speed was never doubted, it was never officially recognized.

Valves in the Head

This giant Fiat has its four cylinders cast in one block, with valves mounted in the head and driven by an overhead camshaft concealed under an aluminum housing, this arrangement tending to increase the height of the motor, which stands more than 5 ft. from the ground. The vertical shaft driving the overhead camshaft is at the rear of the group of cylinders, while the water pump and magneto are respectively to left and right of the casting and driven off a cross shaft. Despite its size, the motor is a remarkably clean design; its hood fits around it as closely as a suit of clothes made to measure. The drive is taken through a three-speed gearbox, jackshaft and side chains to the rear wheels. This car has seen little road service. When it was submitted to the French authorities it was refused the technical license without which no car can be driven over French roads. At the present time it is in cold storage at the Fiat factory.

Although the 300 hp. Fiat has been the most spectacular of big cars, it has to take second place in matter of size to a 350-hp. Fiat with which Nazzaro made some demonstrations on Brooklands track three or four years ago. The engine in this case had a bore and stroke of 9.4 by 12.6 in., giving a cylinder capacity of 3498 cu. in. It was estimated that this car would show a speed of 155 m.p.h., but as events proved, it was practically impossible for any single man to hold it on the road. It was not well proportioned and many thought it should have had a wheelbase of 16 ft. or so and, perhaps a 72-in. tread. After the trials on Brooklands track the car was returned to the factory, the motor eventually serving aboard a racing boat.

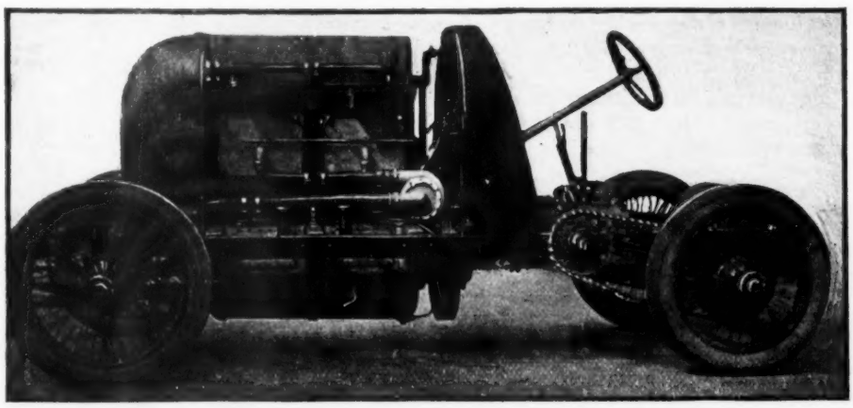
Some Big Benz Motors

Benz has been responsible for some very big racing motors, the most successful of which was a machine of 7.87 by 9.8 in. bore and stroke, giving 1913 cu. in. piston displacement. This car climbed Gaillon hill, near Paris, one kilometer in length, with an average gradient of 8 per cent, at an average of 101.5 m.p.h., thus creating a record which remains unbeaten.

The biggest Fiat long-distance road racers ever built were the machines with which the late David Bruce-Brown took part in the French Grand Prix at Dieppe, in 1912. These cars had four-cylinder motors of 6.1 by 7.87 in. bore and stroke, giving 920 cu. in. piston displacement. They were defeated by the Peugeots of only 447 cu. in., this being the biggest racing car ever built by the French firm. It was this same Peugeot car which won the 1913 race at Indianapolis.

Tendency Toward Smaller Engines

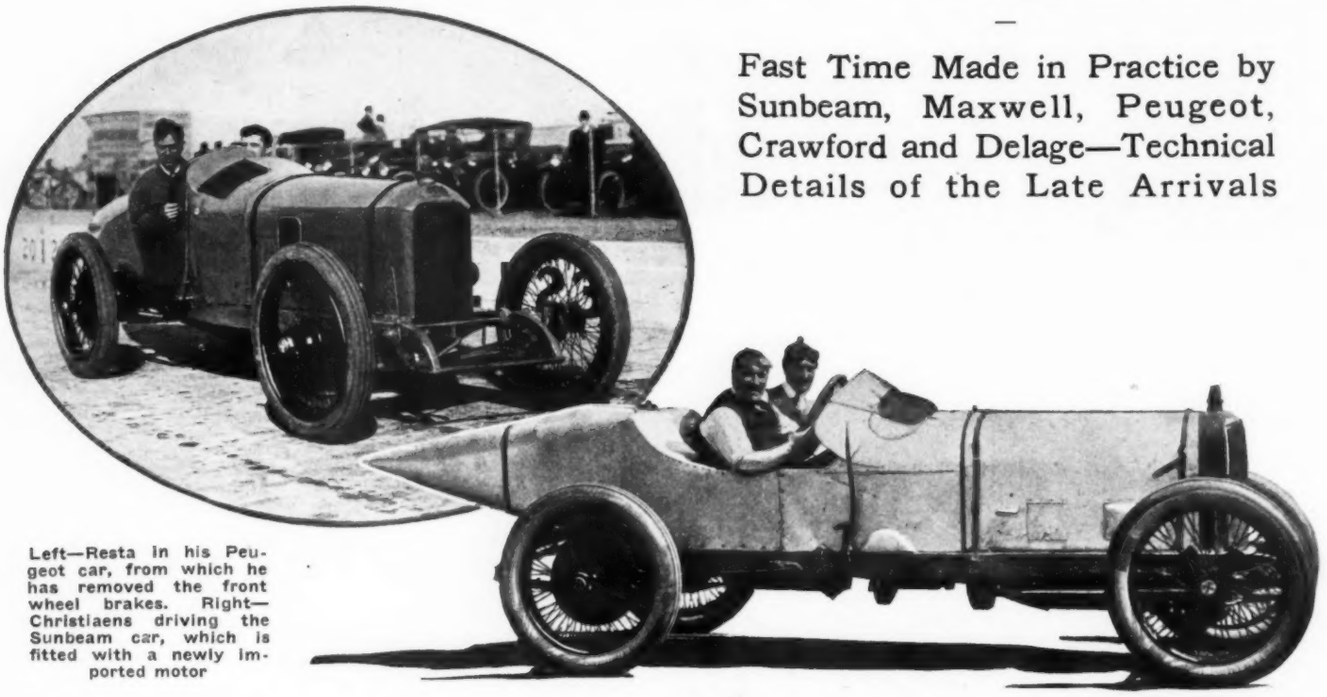
There are indications that for record-breaking stunts, and for the publicity which they secure, the building of big freak cars will be continued. Nevertheless, for competition work on road and track the whole tendency is toward smaller and smaller engines. An example of this is shown in the case of Peugeot, whose biggest racing engine had only 447 cu. in., and was barely capable of 100 m.p.h. A smaller car of 275 cu. in. piston displacement, showed a speed of 110 m.p.h.; the smallest car, built just before the outbreak of war, and not yet seen in public, had 152 cu. in. and showed a speed of 95 m.p.h. average over the measured kilometer. Had it been possible to put this little machine in the 1913 Indianapolis race it would doubtless have defeated Goux's 447-cu. in. Peugeot, which covered the 500 miles at an average speed of 75.94 m.p.h., beating Wishart's Mercer by 13 min. and 8 sec.



Exhaust side of 300-hp. Fiat chassis. This view gives an idea of the height of the motor in proportion to the wheelbase

1916 Racing Cars at Sheepshead

Fast Time Made in Practice by Sunbeam, Maxwell, Peugeot, Crawford and Delage—Technical Details of the Late Arrivals



Left—Resta in his Peugeot car, from which he has removed the front wheel brakes. Right—Christiaens driving the Sunbeam car, which is fitted with a newly imported motor

NEW YORK CITY, May 9—Day by day the activity on the Sheepshead Bay track is increasing, and about the line of garages beneath the curved sides of the great 2-mile bowl there is a hum of excitement and preparation for the opening of the racing season of 1916. On the track Christiaens in his Sunbeam, Billy Chandler in his Crawford, Ralph Mulford in the Peugeot, Rickenbacker and Henderson in Maxwells, and Miller in the Mulford Special are already trying out their mounts in preparation for the event of May 13.

Considerable interest attaches to Christiaens' Sunbeam, as it is a brand new motor, built with the special intention of bringing racing honors back to the Old World. The chassis of this car is the same that appeared in races in this country in previous years, but the motor has never been used until its arrival in this country, except for a few short trial spins at Brooklands. It is said that a sustained speed of 115 m.p.h. is not beyond the possibilities of this engine, and the car is looked upon as one which is sure to make itself heard from in this year's events. The motor is a six-cylinder design with a bore of 81 mm. and a stroke of 150, or approximately 3 3/16 by 5⅞ in.

One set of spark plugs is used, these being placed in a single line along the center at the top of the cylinders. The current source for ignition is a single Bosch magneto driven at three-quarters engine speed. There are two oil pumps, one which provides lubricant for the ball bearings supporting the crankshaft and the other for the two camshafts. A feature of the motor is the individual breather pipe for each cylinder.

Four Valves per Cylinder

Twenty-four valves, four to a cylinder, are employed. The camshafts driving these are mounted overhead, and the valves are set at an angle in the top of the cylinder head. Camshafts are driven by a vertical shaft and gears from the front of the engine. Christiaens' old specialty of two carbureters is again in evidence on this car, which is fitted with two neat intake manifolds, providing an interesting layout for gas distribution.

The gearset has four speeds with a final reduction on direct of 2.7 to 1. The car is equipped with a revolution counter, and the exhaust manifold is carried outside of the hood with a pointed entrance line.

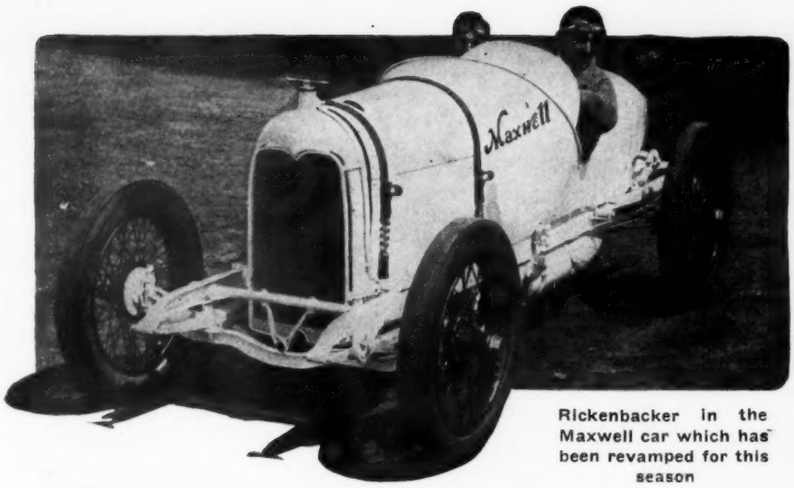
The sixteen-valve Duesenberg motor used in the Crawford cars should also be of great interest in the coming race and in other events on the national circuit. This motor is the one which was experimented with last year but which was completed too late to be used in any of the events. It is built very much along the same line as the eight-valve Duesenberg, having the valves operated by long rocker arms on the side. These rocker arms extend up the side of the motor and act directly on horizontally-placed valves located above the cylinder.

The Duesenberg motor stood up well in last year's races. At Indianapolis the car driven by Alley suffered no trouble of a mechanical nature beyond a loosened exhaust pipe. O'Donnell stopped only three times at Indianapolis, and his mechanical adjustments consisted of the replacement of a nut, which had jarred off the brake bracket, and a quick adjustment of the shock absorber. On the whole, these cars performed very consistently throughout the entire season and, while they were not so fast as some of the other entries, were generally in the money on account of their steady performance.

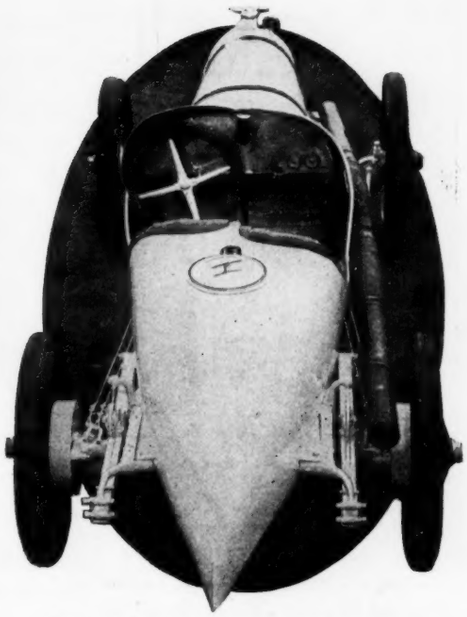
With the new sixteen-valve motors the same reliability should be acquired with an increased amount of speed, due to the greater gas passages, and a creditable performance is generally expected.

The Maxwell Racers

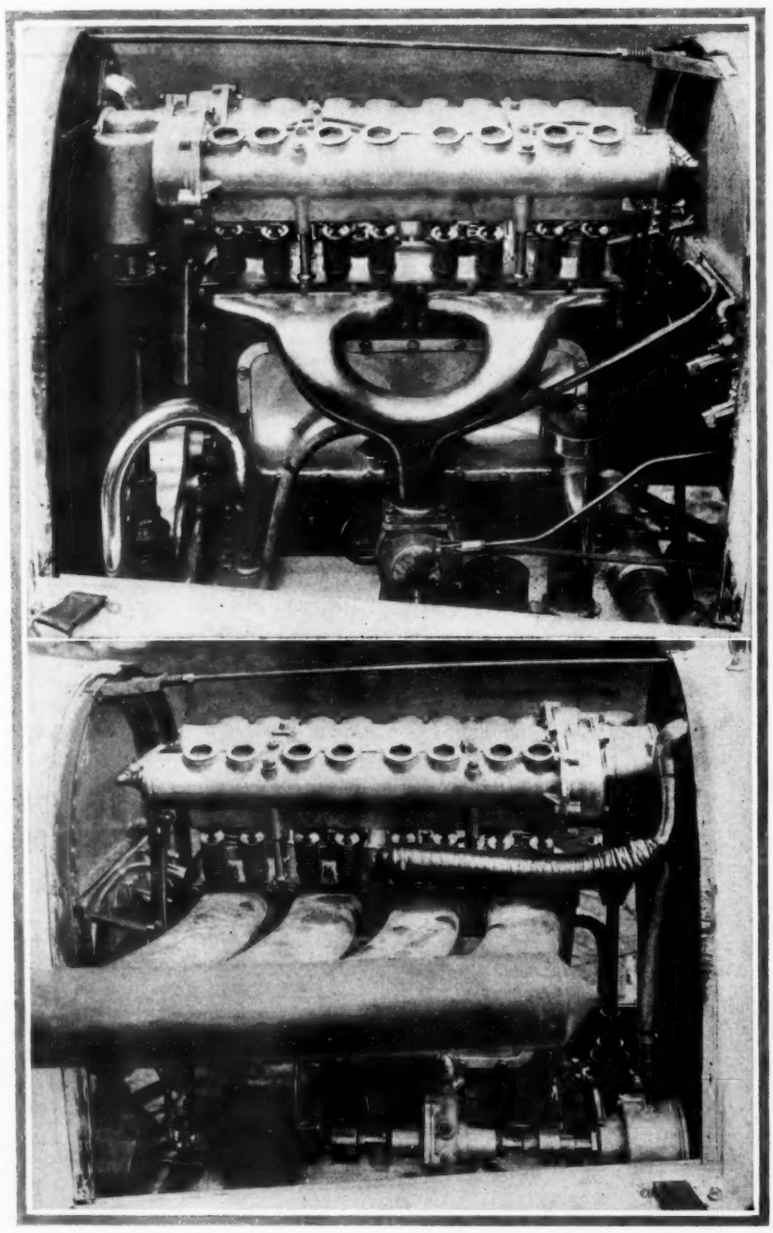
Every once in a while a flash of white around the 2-mile saucer betokens the presence of the Maxwell racing cars of the Indianapolis team. These cars are faster than the Max-



Rickenbacker in the Maxwell car which has been revamped for this season



Stern view of the Maxwell car showing the new pointed tail piece



Intake and exhaust sides of the new engines now fitted in the Maxwell chassis

wells of a year ago, due to the incorporation of a number of detail changes calculated to reduce the wind resistance and to increase the motor efficiency.

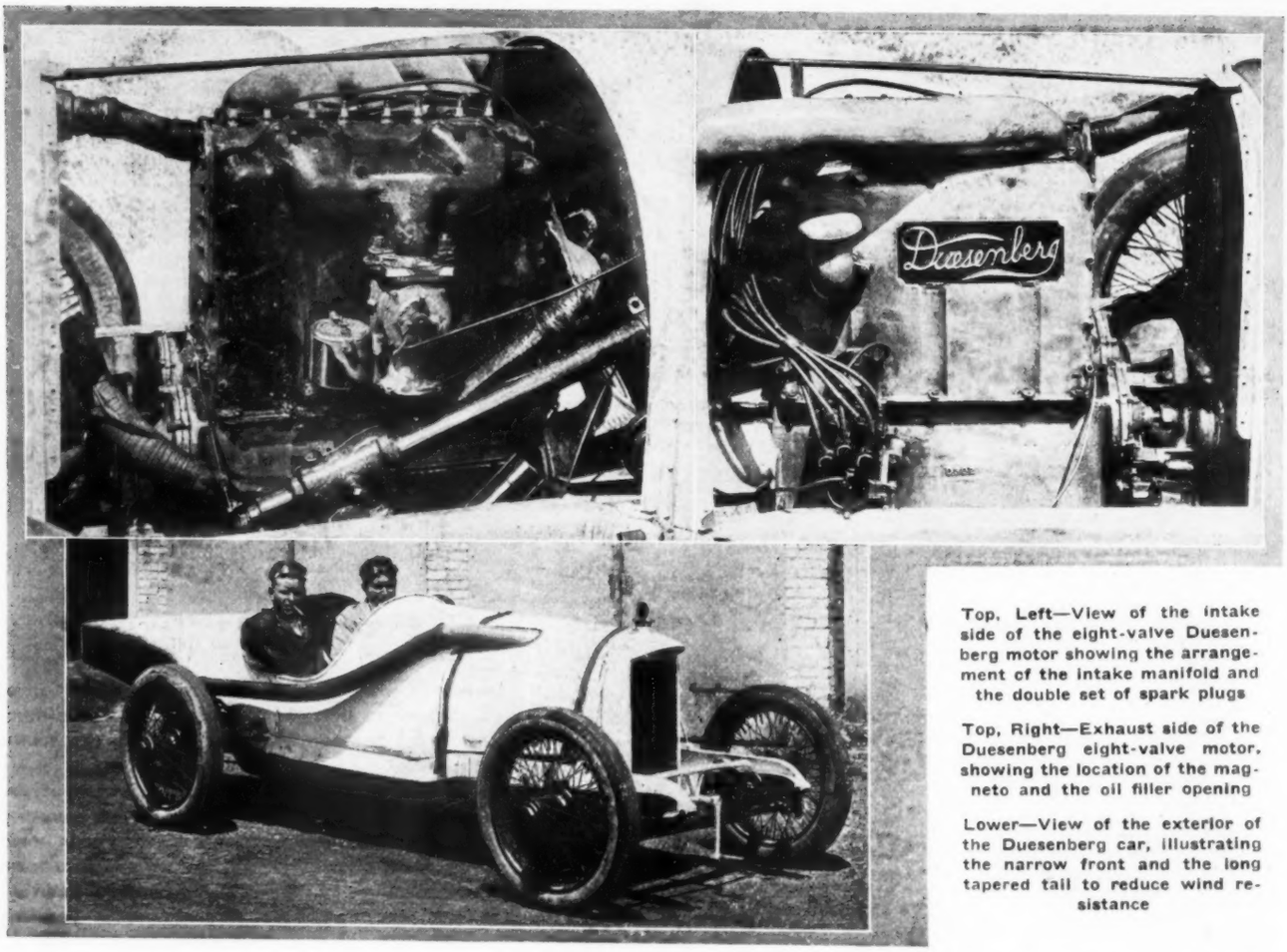
Instead of the stub-ended rear portion of the earlier cars, a long tail has been fitted, designed to a true streamline form, and thus cuts wind resistance to the minimum. Within it is carried the fuel tank of very large capacity with an exceptionally large opening, by which gasoline can be dumped into it in record time. This is the main fuel supply, and is by pressure. In addition there is an auxiliary fuel supply of less capacity, carried in the cowl, and which feeds by gravity, so that if the main supply becomes exhausted the driver can run in on the auxiliary by throwing a valve underneath the steering wheel.

The motors incorporate the only other changes from last year's practice. In most respects they are identical with the 300-in. sixteen-valve motors of the Maxwell team of 1915. Like those motors, they have a bore of 3¾ and a stroke of 6¾. These dimensions bring the displacement to just within the limit. To be exact, it is 298.2 cu. in.

The valve sizes have been changed slightly, the intakes being increased to 2 in. This is ¼ in. greater diameter than in the 1915 racers. The exhaust valves have not been changed, but the lift of all valves has been increased ⅛ in., the cams opening now 7/16 in.

The divided intake manifold of the 1915 cars has given way to a more direct and probably more efficient intake, in which the whole side of the cylinder head casting above the intake valves is opened up to the gas, thus giving a blanket of fresh gas over the entire intake valve area. Incidentally, the new manifold has been copper-plated and rounded off.

The original practice of having a large carbureter intake air horn outside the hood has been discarded, and the new cars have the whole within the bonnet.



Top, Left—View of the intake side of the eight-valve Duesenberg motor showing the arrangement of the intake manifold and the double set of spark plugs

Top, Right—Exhaust side of the Duesenberg eight-valve motor, showing the location of the magneto and the oil filler opening

Lower—View of the exterior of the Duesenberg car, illustrating the narrow front and the long tapered tail to reduce wind resistance

The oiling system has been changed somewhat, chiefly through the use of a triple-gear pump instead of a double one employed earlier. The system is a force-feed circulating type, in which fresh oil is drawn continually from a torpedo-shaped oil tank under the frame and returned to the tank after use. This keeps the oil cooler than would be possible otherwise. The details of the method of forcing the oil through the hollow crankshaft and camshaft to the connecting-rods and main bearings have been dwelt on before.

Uses Unique Crankshaft

The real feature of the Harroun motor as exemplified in these Maxwells of the Prest-O-Lite team, is the unique counterbalanced crankshaft construction, which eliminates the flywheel. This has not undergone any change for the past season.

Connecting-rods still are made of chrome-vanadium steel, and have been subjected to accurate machining over all. The I-beam section is further strengthened by forging webs on either end of the section, making a very sturdy rod.

The use of magnalium pistons is continued. The piston heads are domed to give them strength, and each has five rings. There are two diagonally split rings in each of the upper grooves and one wider ring below, which is used for a retainer for the wristpin. The use of magnalium reduces the piston weight from over 2 lb., the weight of a similar cast-iron piston, to about 15 oz.

In explanation of the counterbalanced crankshaft, it might be explained that the flywheel function is distributed along the entire length of the crankshaft, and is productive of fine engine balance. The counterbalance weight opposite each rod bearing is equal to the weight of the lower part of the rod and its bearing; thus the active forces are balanced with respect to the center of gravity, and the centers of masses revolve in the same or parallel planes. Vibration is materially reduced thereby.

The cylinders are cast in a block, and the head, carrying the valves, their rockers and the camshaft, is detachable. Intake and exhaust passages are on opposite sides of the casting, and they are large and free, so that the least possible interference with the passage of the gases to the manifolds is obtained.

Billy Chandler in the Crawford car which is equipped with a Duesenberg motor

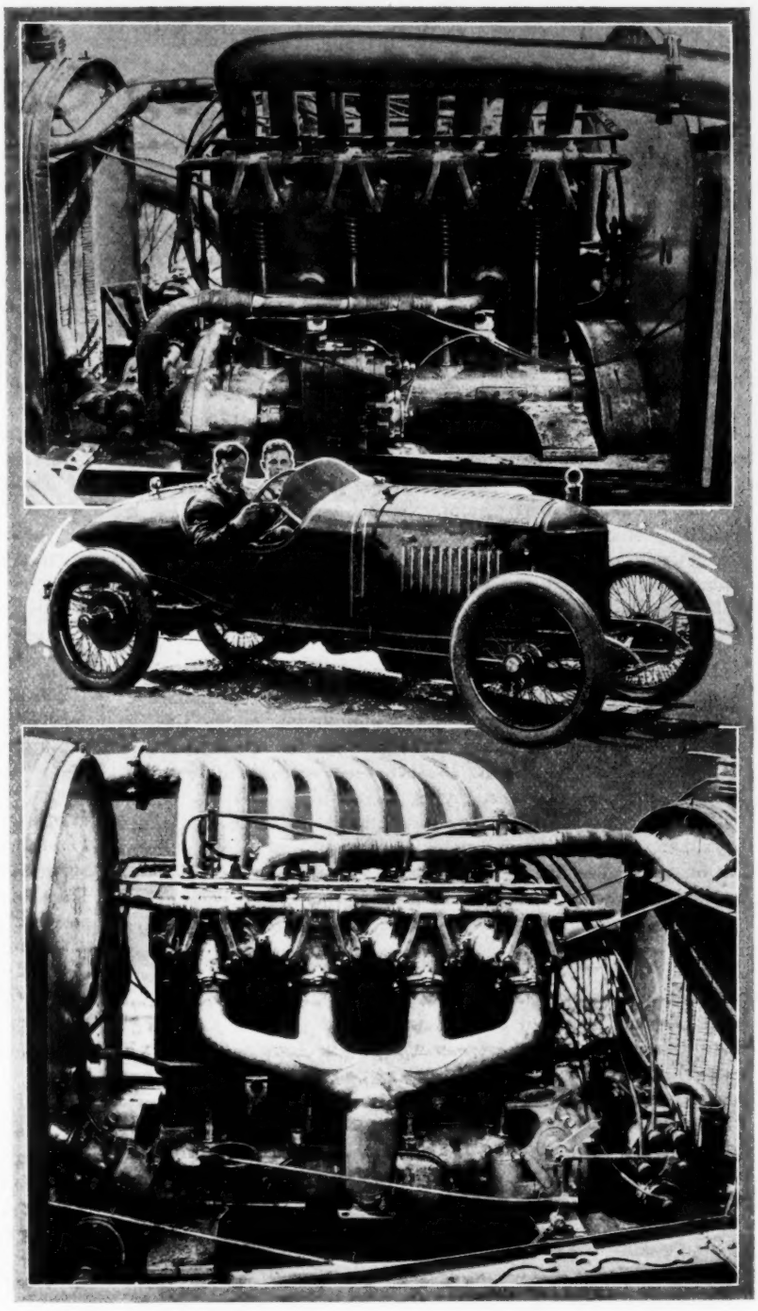
Although there are four complete cars, all in shape to make fast time, it is the intention to use only two of them in any race, holding the other two back for emergencies. In addition to the two completed cars held in reserve there is a very complete supply of spare parts and a thorough system of shipping and storing of parts so that they will be on hand when needed. One of the features of this preparedness program includes a combination motor stand and shipping crate; another, a parts bench, which becomes the parts locker for transportation. Altogether Rickenbacher, the team manager, has made very thorough plans for a successful campaign.

Mulford Special Withdraws

The Mulford Special was out on the track without its complete body, but is now withdrawn due to motor trouble. The motor in this car disclosed little from an exterior view. It is a square block in appearance, having four cylinders 3.98 by 6, giving a piston displacement of 299 cu. in. The valves are operated by vertical rocker arms. Everything is being done at the present time to make this car faster. In the last Sheepshead Bay race the Mulford Special was flagged at the 274th mile.

The Erwin Special has been out on the track for a few short trial spins but has had a little trouble with the engine, probably due to the fact that the bearings have been set up too tight. The engine is the same as the Erwin of last year, while the chasis is new although of similar design to the former one. The car is made by the Erwin Motor Machine Co., Philadelphia, Pa., and has a bore of 4 and a stroke of 5 15/16 in. The cylinders are L-head, cast in pairs, with the intake valves in the head and the exhaust valves on the left. All the valves, however, are operated from one camshaft. Rudge-Whitworth wheels with 33 by 5-in. tires are being used in practice. The wheelbase of the car is 108 in.

Harry Harkness's team of Delage cars which were described in THE AUTOMOBILE fully on March 23 have been showing excellent speed on the track and if they have the stamina of the other old Delage whose motor is illustrated on this page they should be well to the front. The new tails that have been fitted make them suitable for speedway work and they have created a good impression.



Intake and exhaust sides of the older type of Delage motor with the Delage car in the center

The engine of the new cars are considerably different from the older motors as the horizontal valves have been abandoned. There are now four valves per cylinder arranged in the head in the usual way at an angle of about 45 deg. The two camshafts are driven by a single vertical shaft with a nest of bevel gears at the upper end, the spark plugs being in the center of the cylinder heads. A small peculiarity is that the cylinders are bolted on from beneath the studs fitting in the cast iron foot with the nuts inside the aluminum crankcase. The valves are operated positively in both directions by a stirrup which passes right around the cam, only a cushion spring being interposed, so there can be no possible lag in closing.

There are two Claudel carbureters on each engine, operating simultaneously with throttles interconnected.

The engines are well within the 300 cu. in. limitation being 94 by 160 mm. or 3.7 by 6.3 in. This gives a piston displacement of almost exactly 270 cu. in. The wheelbase is 106 in., and the tires 34 in. diameter on Rudge Whitworth wheels.

Just back of the seats there is an immense tank for gasoline and oil, the latter being fed by hand pump when desired, and circulated in the engine by a centrifugal system.

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The National Road

A book which should help give to the noted highways of America the prestige they deserve by awakening a greater appreciation of them among motor tourists has been written by Robert Bruce under the title "The National Road." It is descriptive of that historic thoroughfare, the old National pike, running from Baltimore, Md., and Washington, D. C., via Frederick, Md., and Cumberland, Md., through southern Pennsylvania, to Wheeling, W. Va., and so to the banks of the Ohio River.

Paragraphs on Current Topics

By MARIUS C. KRARUP

Many are thinking worm gear. Worm drive for trucks. Worm drive for electrics. Why not worm drive for light cars? Nay, even two worm drives in tandem might be arranged and the gearbox dispensed with. Or perhaps three would be easier to manage, with two of them to be cut out to give direct drive. What delightfully silent little cars that would make. But halt. "Never pick up a snap" is a safe rule, which translated into mechanics means that the obvious is usually not so. Trouble lurks somewhere. Have you thought of coasting efficiency? Well, the light car needs a lot of coasting efficiency, and the worm drive, even of 45 deg. pitch, has not any to spare. We would like to know just how great the coasting efficiency of a worm gear can be made, and we know of others to whom it would be useful to know it. Coasting efficiency is the winged word of conservatism in worm gear speculations at present and has to be considered, though it need not be accepted as an insuperable bar to hopeful planning.

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May we say it is the employment of a suction which is beyond direct control that has made carbureter construction difficult, still makes carbureter adjustment ticklish and necessitates many sizes? To be sure, a 900 r.p.m. suction can be managed so as to pull itself up to a 2000 r.p.m. suction in a few seconds, giving as rapid acceleration as is usually wanted. This is marvelous, but a better action could have been accomplished much more simply with compressed air on tap. The Decupli system of forced induction demonstrated so much, at least, several years ago. To remind us, it is illustrated on another page.

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Citified automobilism is well along, but here—at the movies—we see an armored motor car stalled in Van Cortlandt Park because one of the front wheels has sunk into the soft ground and not more than halfway to the axle. Volunteer soldiers are digging it out. The scene is filmed to exemplify Preparedness work. But a wheel that would roll out of the hole would seem fully as patriotic to some of us, so much more as the design—in the case of a front wheel or a trailer wheel—is almost obvious.

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When publicity ceases, stagnation and worse sets in; competition is corrupted. Without the searchlight of public comment constantly playing on every detail in automobile and motor truck construction, furnishing the facts and nomenclature for thousands of interested discussions and conversations all over the land, can anybody imagine just how much the zest for improvements would have lagged and how much smaller the pressure would have been for combining high quality with economical construction? Where publicity has met the greatest obstacles and has been farthest behind—as in all matters relating to durability and in all details and refinements of motor trucks and delivery wagons—there too the accomplishments of the industry have been least worthy of admiration. Why these remarks, trite and self-evident? They are for the express benefit of truck salesmen who unexpectedly and suddenly lose promising prospects without knowing why. They have run against the axolotl. An axolotl is a blind newt having its habitat in subterranean waters, but it is also a motor truck made to be sold through the influence of interlocking directorates. No ray of light is shed upon its construction from outside of the charmed circle. Its parts yield profits to several sets of directors. Its assembling and sale to other directors and bankers. In the corporations which purchase the axolotl trucks to do their transportation work there are directors who make three profits on the deal. If there are shortcomings in the construction, the common shareholder in the purchasing concern will pay for them. It is his lookout. And he sits in a subterranean cave with no ray of publicity to help him see, no disinterested comment to make him hear. Truck construction is not yet quite far enough advanced and, especially, the public appreciation of the requirements is not yet so ripe and deliberate as to make this sort of development a welcome feature. It courts abuse of confidence and discourages fair play. But there is no remedy, it may be said, if those who are to pay the bills are not bright enough to look out for themselves. How about contests? Such contests, for example, as the army departments of foreign governments have held to determine what makes of trucks should be entitled to subsidy or what price should be paid for them.

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Truck contests in the past have been uninteresting and inconclusive because everybody knew that durabilty, the main factor in serviceability, was not tested.

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In a tight place in the traffic we press the accelerator hard to jump out of the squeeze. But there is a little time gap between the actuating of the pedal and the desired movement. This important little gap varies for different cars, and in acceleration charts, by the Wimperis accelerometer, it does not seem to be recorded. In comparing acceleration by test for different types of motors, it might be interesting to plot a separate curve for the gap, beginning with the intention to accelerate and ending one to two seconds later. Most of the luxury in prompt acceleration is concentrated in this period.

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Differentials always do what they are designed to do. They are forgotten when weather and roads are fine. If there is trouble it is because the road or one of the wheels fails to do its part in operating the differential. Every improvement, so far, consists in making it differentiate less perfectly; making the axle operate more nearly as a unit when one of the tractor wheels fails to tract. The next step in this direction is the solid axle, which is now proposed for trucks. Probably it is a question of average road conditions which method will involve the greater expense for wear of tires and extra demands upon the motor power. There are some other possibilities. The free wheel in conjunction with a reverse gear whose operation automatically locks the wheel has not been fully tried. But the radical remedy relates to the wheel. With caterpillar traction the differential has only its cost against it. Eventually there must be developed a real "automobile wheel" whose traction will be reliable enough to relieve the differential from unmerited blame. We see it coming by way of army trucks, agricultural tractors and light steel castings or sheet steel construction.

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Specifications for army trucks have been framed, on request of Major-General Leonard Wood, by Robert McAllister Lloyd, W. P. Kennedy and Joseph A. Anglada, all of the S. A. E. metropolitan section, in consultation with Captain Gordon Johnston and Major C. S. Lawton. The specifications are in

three classes, representing first, second and third choice. The object is the double one of guiding the army authorities in purchases and the truck manufacturers in construction, as well as to have a large percentage of commercial trucks eligible for army work. It would be a remarkable vindication of this method if the new specifications were locked up for a while and the work done over again with three other engineers—say from the Detroit section—and substantial correspondence was found to exist in the results in both instances. Should divergencies appear, a most excellent debating material, for both army men and truck builders, would have been created, much for the advancement of the cause.

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It would be interesting, in addition, to stage carefully all those army requirements which are special and indispensable, have them visualized in a few hundred photographs with explanatory captions, have all of these published or distributed in full sets and invite all S. A. E. members to specify means for meeting the needs. Division into as many classes of vehicles as the army men think should be allowed would simplify the designers' work.

Forced Fuel Feed vs. Automatic

VARIOUS means for operating a motor at will with a charge higher than its normal maximum and with the compression correspondingly increased have engaged attention, with a view to getting high power and speed from a small motor and an economical power development over a much wider range than would be at disposal by using a larger motor. In the ordinary high-speed motor a similar object is accomplished mainly by large overhead valves, narrow valve faces, increased valve lift, internally polished induction pipes with a minimum of abrupt bends, suitable valve timing and a number of refinements necessary for taking care of the inertia forces. In comparison with these means, or in conjunction with them, the system of forcing the intake of the gas and air charge has the advantage that it may be used for increasing the force of explosions at slow motor speed, when the motor is handling an overload, and that the surcharge at any speed can be made much greater; in fact so large as to involve the risk of burning out exhaust valves and plugs and injuring the motor generally. Additional interest attaches to the whole idea of forced intake now, because it gives promise of assisting greatly in reaching complete success in the use of other fuels than gasoline, especially kerosene and alcohol. This prospective advantage depends upon being able to apply the forced intake at any desired point in the cycle, rather than being limited to the suction stroke.

The most practical example of forced charging was the Decupli arrangement, which was described and illustrated in THE AUTOMOBILE in 1912, when it was fitted in a car and submitted for trial to the French Automobile Club. Eric Walford draws attention to this construction again in a recent issue of *The Autocar*, giving the illustrations which are reproduced herewith. Fig. 1 shows diagrammatically the general arrangement in fitting the system to the test car.

Alongside the gearbox there is mounted a short shaft driven by a belt from the clutchshaft and carrying a clutch, so that the pumpshaft can be rotated or not, at will. At the rear end of the shaft is the compressor supplying compressed air to the carbureter, which is of the construction shown in Fig. 2.

With modern provisions for motor-starting and electric lighting, these cumbersome arrangements can evidently be much simplified, and the facilities now existing in this respect are among the factors causing renewed interest in the subject.

In the carbureter there are two jet nozzles, *A* and *B*, the former operating in the usual manner when no forced charging is desired. At such times extra air for the carbureter enters by the valve *C*, which is interconnected with the throttle. When compressed air is supplied, on the other hand, the plunger *D* over jet *B* rises, uncovering this second jet. Supplementary air and safety valves are provided, as shown in the cut, and the float chamber is in communication with the spraying chamber, so as to balance the pressures.

At the trial this system was fitted to a 12-hp. Mors car and the records show that the car climbed a hill at an average speed of 24 m.p.h. without making use of forced charges, and that it was possible to raise this speed to 33.6 m.p.h. by admitting the compressed air, such admission producing at once a forward leap of the car, the weight of which was 3360 lb. It was figured that the charge forced into the cylinders with the Decupli device was double the normal maximum, which would also nearly double the compression and probably set up stresses so high as to call for special design in many details of the motor.

The situation looks different in many ways when it is contemplated to have the cylinders draw their normal charges in the usual manner and to employ the compressed air only for introducing the surcharge at a later moment; or else to draw in air alone by suction and shoot in the fuel with a little additional air later, as should be especially suitable for fuels whose vapor, as that of kerosene, is liable to cracking while exposed to a temperature which is not quite sufficient for ignition.

In Diesel motors with high compression the air-compression plant is said to absorb an average of about 6 per cent of the power output, and it may be doubtful if any smaller allow-

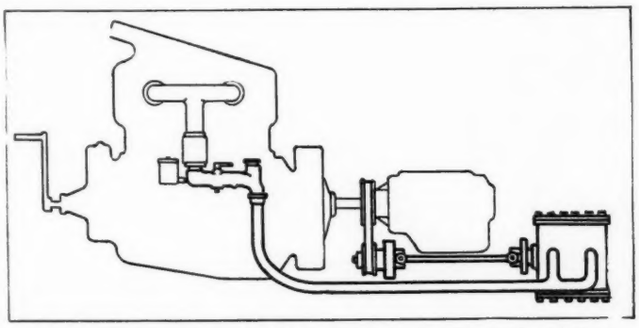

Fig. 1—Arrangement of drive, compressor and carbureter in Decupli system of 1912

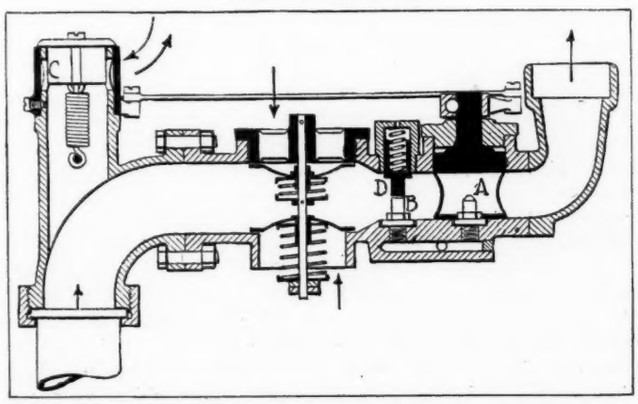

Fig. 2—Construction of Decupli carbureter for increasing fuel charges by compressed air

ance should be estimated for automobile motors whose small dimensions would make for lesser efficiency in this detail.

The Blower System

Mr. Walford, in his above-mentioned review of the attempts made to materialize forced induction as an adjunct to motors not originally designed for it, mentions those made by Alexander in 1907, by Kessler in 1909 and by Lewis a year or two later, as well as a patent by Gore which does not seem to have been tried in practice. In a general way it is found that neither the use of air compressed in the crankchamber nor that of force blowers is fully acceptable.

R. M. Alexander used a blower in the inlet pipe between the carbureter and the engine and obtained a decided increase of power. The fan used was about 6 in. in diameter and was run half as fast as the engine by means of a friction disk actuated by the flywheel.

If a blower were placed so as to force air through the carbureter it would interfere with the carbureter action, so long as this depends upon producing an atmospheric depression around the fuel jet in order to draw the fuel out. This objection may be overcome, however, as in the Decupli device, by putting the float chamber and the fuel tank into communication with the inlet side of the carbureter.

The blower device fitted by E. W. Lewis was coupled direct to the induction pipe and drew gas from the carbureter without the use of any reservoir between the engine and the blower. Its dimensions were large and cumbersome and no tests were made to determine approximately what gas pressures or horsepower were produced.

The Kessler system was applied to a two-cycle motor fitted to an American Kessler car which was taken to England in 1909 and tried out on the Brooklands track. The principle was that of utilizing the piston stroke for compression of air in the crankchamber and sending this air into the other cylinder in addition to an almost full charge introduced by suction. The four-cylinder motor developed great power at all of the three gear speeds, but was very noisy.

In another instance a four-cylinder, four-cycle motor of the horizontal type with two opposed air-cooled cylinders was operated with forced charges on a principle similar to that used in the Kessler two-cycle motor, and in this as in the other cases there was no doubt about the increase of power; but the attending drawbacks, both in construction and operation, pointed to larger size of the motor or the usual expedients of high-speed design as being preferable for attaining the desired power and acceleration.

Summarizing the Impression

The data on forced fuel feed to the cylinders are vague so far. One feels that the experiments which have been made were partly on the wrong track. The idea of forcing power and speed by cramming the cylinders overfull with explosive charge does not appeal strongly to mechanical sense; not at this date. But there is a larger view. The methods used for cramming the cylinders point to better ones which may be used similarly but for a more moderate purpose: For improving carburetion, cylinder-charging, combustion, lubrication, acceleration; for introducing an improvement over the automatic cylinder-charging now universal; an improvement likely to prove more important than the change, of old, from automatic to mechanically operated inlet valves, which was the beginning of higher-speed motors and decisive for efficiency and motor control.

It is known that the practical limits for high motor speed can be reached and exceeded without more than full charges in the cylinders. The difficulties which set these limits must operate even more strongly against additional forcing of the charges. But if, for example, the extreme valve timing which is resorted to in racing motors could be avoided, as seems more than likely, by positive cylinder-charging—supplementing a partial charge with air by suction—the useful range of motor speeds would be largely increased, and the high-speed motor would become flexible as well as powerful and economical.

This and the relation to other fuels than gasoline lends the subject an interest which must continue to grow and must result in many experiments in the industry.—M. C. K.

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Rule for Obtaining Correct Tension for Silent Chains

THERE is nothing that is so destructive to a silent type chain as is running it slack. If the tension is incorrect the slack side "thrashes" and this quickly beats the life out of the chain. Probably a large percentage of chains used for electric generator or starter drives give much less service than they ought to do because they are allowed to get slack. The automobile owner and even the repairman is often at a loss to decide how tight a chain ought to be, hence the opinion of an expert is of great value. F. L. Morse, maker of the Morse rocker joint chain, gives the following simple rule for obtaining correct chain tension. It is:

"Tighten the chain by the adjustment till it growls when running; then slack it off by slow degrees till the growl just ceases. The chain is then at the right tension."

Mistakes Impossible

Mr. Morse also says the adjustment is so easy that to make a mistake is almost impossible. Nearly everyone with any mechanical knowledge knows the way to adjust a cup and cone ball bearing, namely, to tighten it till it runs stiff and then slack back the cone till it just, and only just frees itself. The method for chain adjustment is almost exactly similar. Mr. Morse gives as his opinion that adjustments ought to be made as accessible as possible, since any owner can keep a chain properly tensioned without professional assistance, if he can get at the adjusting nut. He considers inaccessible adjustments militate against the proper maintenance of tension and so against the life of chains.

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Dodging British Taxation

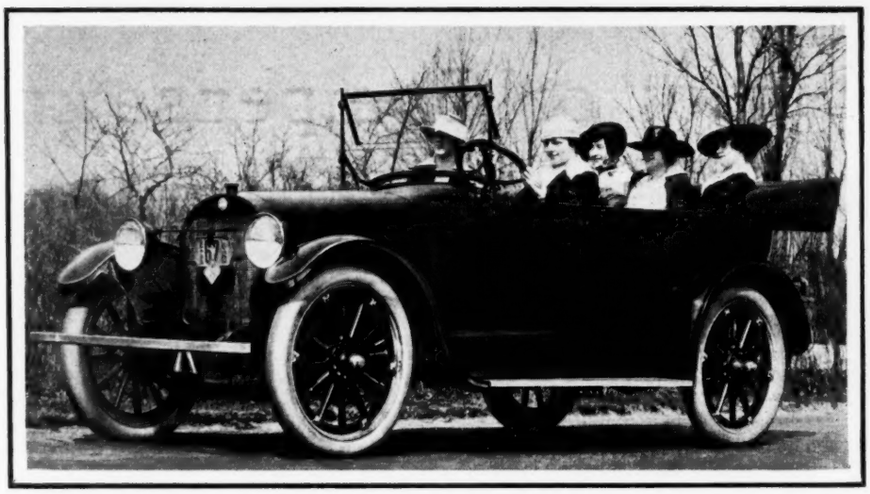
THINGS are usually supposed to move slowly in Great Britain but something seems to have been doing since the motor car taxes were raised. The government has just announced a new schedule of horsepower taxation to come into force in June which makes the annual license fee for Ford cars $90.72, three times the old tax. The Ford suffers because it has a large bore and falls in the class between 80 mm. and 102 mm. which has this sum as the annual due.

It is now announced that a company is in course of formation and will commence operations immediately, to supply cylinder liners and new pistons which will fit any Ford motor and reduce its bore to come within the next lower tax schedule of $30.24 per annum.

Our British contemporary *The Autocar* for April 22 is filled with letters bewailing the injustice of the new taxes and pointing out how vicious an effect upon design is exercised by a tax upon bore which takes no regard for stroke or total piston displacement. *The Autocar* in an editorial points out that the money must come from some place and suggests that if the automobile is to be taxed as heavily as this the same total amount could be raised more fairly by charging so much per 100 cu. cm. (about 6 cu. in.) as this volume normally produces about 1 hp. Even this, it is pointed out, falls harshly upon owners of old cars with large, inefficient engines, and this sort of vehicle has been used largely by people of small wealth owing to the low first cost. It will certainly spoil the used car market.

Sun Six Uses Ejector Exhaust

Well Known Parts Used In Assembled Product



Five-passenger touring car on Sun light six chassis, listing with full equipment at $1,095

A LIGHT six-cylinder car has been put on the market by the Sun Motor Car Co. of Elkhart, Ind., in five-passenger touring, four-passenger roadster, and five-passenger sedan style. The touring car sells for $1,095.

Although this is an assembled car, in exterior appearance the lines are characteristic. The wheelbase is 116 in. and this space has been used in a way to give good body room in both the forward and rear compartments.

Has Suction Exhaust Effect

The motor is a six-cylinder L-head 3 by 5 with removable cylinder head and featured by what the Sun company calls a dual ejector exhaust, the idea of this being that the ejector principle is used in having the exhaust from one cylinder create a suction to lessen the back pressure on the next cylinder. Both the intake manifold and the hot air connections for the carbureter are integral with the cylinder casting. The 20-gal. gasoline tank is placed at the rear of the chassis and fuel is fed to the carbureter by the Stewart vacuum system. The carbureter is a Rayfield.

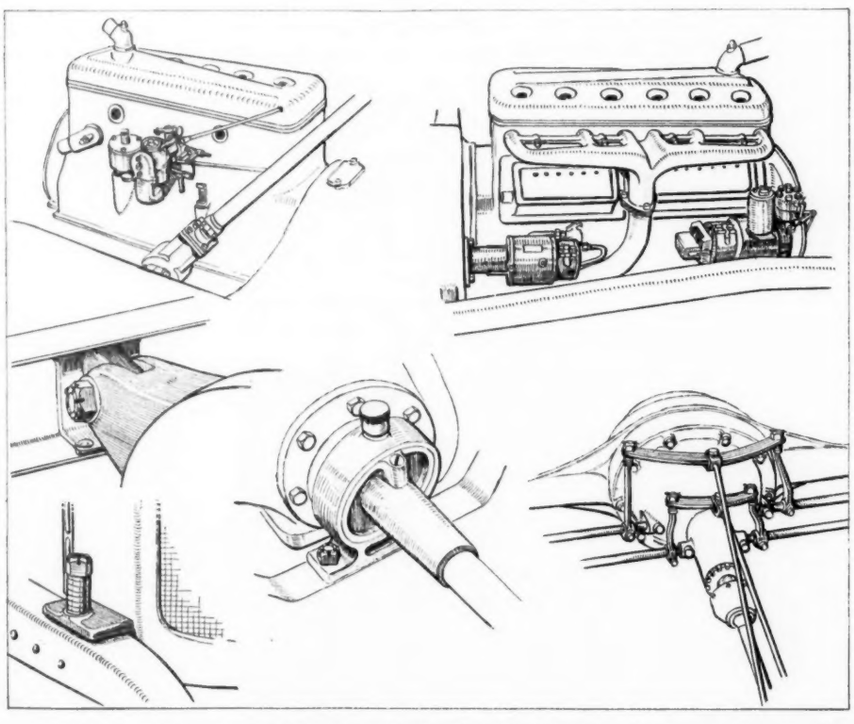
Large diameter valves are used and light pistons. The crankshaft is carried on three main bearings and is balanced by the curved web system in which the crank cheeks are claimed to act largely as their own counter weights.

The valve actuating mechanism is located within the crank case where it is subjected to the spray of oil due to the splash lubrication. Pump circulation is used for the oil which is kept at a constant level in the splash troughs. Circulation of the cooling water is by thermo-syphon. The water circulates entirely around the cylinder wall and the valve seats and both the intake and outlet water pipes are 2⅜ in. in diameter. The radiator is a honeycomb type having a water capacity of 2½ gal.

Single Disk Clutch

From the motor the power is transmitted by a Borg & Beck single plate dry disk clutch to a three-speed selective type of gearset. This is mounted as a unit power plant and the entire unit is supported at three points to avoid distortion. The rear axle is a floating type with the weight of the car carried on a pressed steel housing. Both ball and roller bearings are used to take the drive and weight.

The front axle is an Elliot type with a cup and cone ball bearing. The frame is designed to be rigid, being of channel section 5/32 in. stock, reinforced by six cross members. The frame width in front is 28 in., giving a small turning radius. Semi-elliptic springs are used, front and rear, the latter being 52 in. long by 2¼ in. wide. Cross-rolled vanadium steel is used in their construction and the frame channels are arched over the axle at the rear with the springs swung directly underneath.



Details of motor and chassis features, illustrating simplicity of design in new Sun chassis

Equipment Is Complete

Some of the other features of the car are Remy starting, lighting and ignition, Burd high-compression piston rings, Jacox irreversible steering gear, twelve-spoke wheels, 34 by 4 in. tires with non-skids in rear, one-man top, Jiffy curtains and a full line of equipment.

This includes ventilating rain-vision windshield, electric motor-driven horn, tire carrier at rear of chassis and Firestone demountable rims.

The standard color is Brewster green with hood, fenders and running gear black enamel.

Effect of Compensating Jet

How the Zenith Carbureter Operates and Theories Underlying Its Design

By V. R. Heftler
Manager Zenith Carbureter Co.

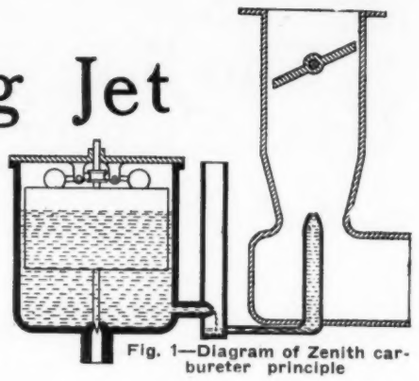


Fig. 1—Diagram of Zenith carbureter principle

THE paper on carburetion read recently before the Cleveland section of the S. A. E. by F. O. and H. O. Ball and published in THE AUTOMOBILE for April 27 provoked considerable discussion, a prominent participator being L. V. Heftler of the Zenith Carbureter Co., who took exception to some of the deductions made by the authors. Mr. Heftler's remarks cover the basic theory of the Zenith design and are thus of considerable interest, and in the following are given practically in full:

Krebs' View of Carburetion

It strikes me that, in the first part of the paper, the theoretical deductions are made under certain assumptions which, as the paper says, are contrary to a more prevalent opinion. This prevalent opinion was presented by Professor Rummell and was contrary to the view of Krebs presented in 1902. Krebs, as all carbureter engineers know, held the view that while the air curve follows a parabolic law the gasoline curve also follows a parabolic law having a slight lag at the start. He attributed this difficulty to the slight difference in level between the constant level and the tip of the nozzle. Krebs determined experimentally this curve lag and he found the corrective term to be equal to 21 mm. when his nozzle was not 21 mm. above the level.

Suggests a Test

It seems to me that, if this law upon which all those curves are based were true, the engineering community would be very much interested in knowing in what manner this new opinion, contrary to the view that we have, has been arrived at. It would be a very easy matter to find out if these considerations are correct; the obvious way to do is to eliminate that disturbing influence caused by the nozzle being too high above the level. We could very easily make, for experimental purposes, a carbureter in which the nozzle should be, say, ⅛ in. below the level. Of course, such a carbureter will be impractical for use in an automobile, because it will spill gasoline while at rest, but while being used to test on the dynamometer, we could find out whether or not that is the cause which prevents the gasoline curve from following the air curve. This would be a simple way of testing that theory. The theory of Krebs, to which Messrs. Ball now revert, was very much opposed by various authors, and the theory that is adopted now by the majority is that the gasoline curve of a fixed orifice is a parabola, but the apex of a parabola is not on the horizontal axis, as in Krebs theory. It is somewhat below.

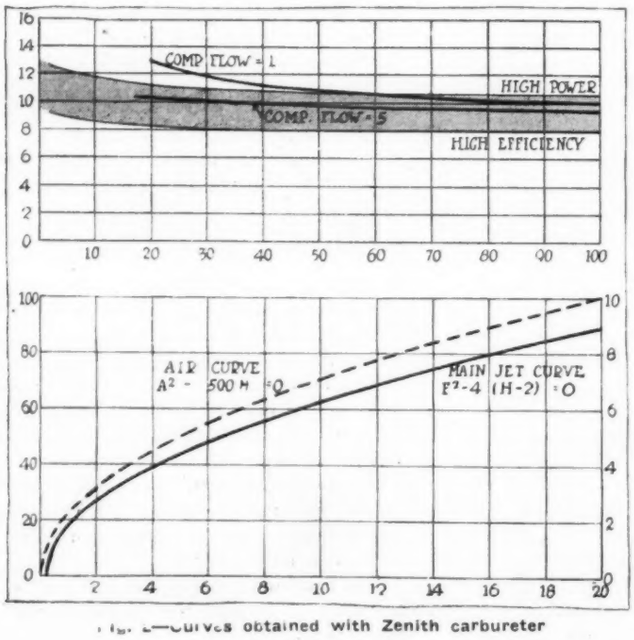


Fig. 2—Curves obtained with Zenith carbureter

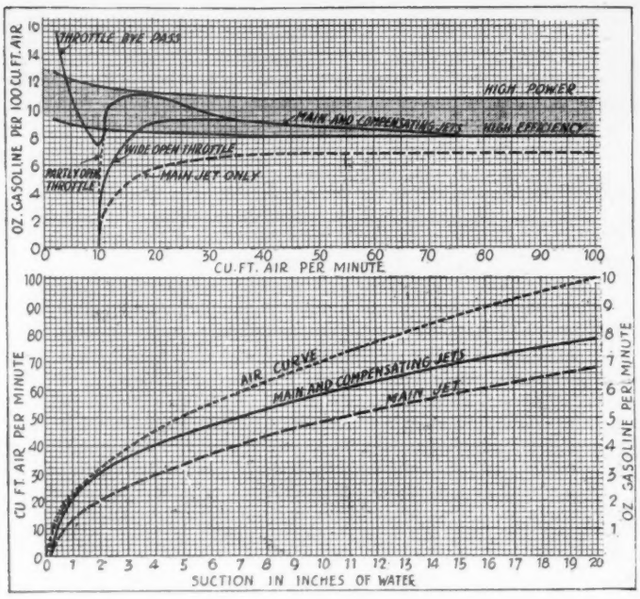
But even taking the premises used in making the theoretical analysis of the various carbureters, I believe that it is possible, at least in one case, to arrive at a different conclusion. I have reference now to Figs. 3 and 4 and to the compensated fixed orifice carbureter. This type of carbureter is described as follows: "A second supply is drawn from a well open to the atmosphere and supplied with a constant quantity of gasoline from the float chamber by gravity." This quotation from the paper reproduces the term of a patent to Baverey, and therefore is referring, and can refer to only one carbureter, with which I am associated. Taking Fig. 4, I have considered the parabolas used in making the curves, and I find that the air curve is very accurately, absolutely accurately represented by the equation $A^2 = 500\ H$ where A is the air flow, and H the suction, and that the fuel curve of the main jet is represented by the equation $F^2 = 2.316\ (H - 0.2)$. These equations can easily be verified.

The Compensating Jet

The compensating jet has been assumed to follow a more complex law. It has been assumed to be constant and give a quantity of fuel equal to 1 oz. per minute provided the suction is greater than 2 in. Before the suction reaches 2, the carbureter jet does not get constant flow. I will see later whether this is justified.

$$C = 1 \text{ provided } H > 2$$

Now, the analysis of this carbureter does not show very well, but the remedy is obvious. If I had a carbureter like that, that does not show very well, I would simply increase some of the jets, and I am assuming exactly the same premises that have been assumed in the paper. The analysis in the paper shows a tendency for the mixture to become too lean at high suctions, while it is about correct at low suction. Let us therefore increase the size of the main jet, that is, change the parameter in the main jet equation. For instance, $F^2 = 4\ (H - 0.2)$. If I were to keep the same compensator, I find that with the quality diagram at 20 cu. ft. per minute, the quality number would be 13, and that at 100 cu. ft. per minute it would be 9.9, but, obviously, all I have to do is to take a smaller compensator. I take for this compensator one



Above—Fig. 3, Below—Fig. 4—From Ball paper curves for carbureter with fixed orifices and compensating device

represented by C = 0.5, the compensator giving only ½ oz. per minute and the quality diagram varies for 20 cu. ft. from 10.5 to 9.4 for 100 cu. ft. What a difference! The accompanying curves show the quality curves with $C = 1$ and with $C = 0.5$. Now, the assumption has been made that the compensating flow obtains constancy only when the suction is 2 in. of water. This might be correct if the carbureter were designed that way. In order to make myself clear, I will make a very rough diagram of what this constant fuel device is like, Fig. 1.

I have very roughly here shown a constant level fuel chamber and I have neglected to show, because it is a complicated drawing, the main jet, the one referred to in the curve as the main jet, so that we have here the constant level fuel, a well open to the atmosphere, a fuel orifice below the level, and a connecting channel terminating in this nozzle. Now, the suction at which the flow of the compensator becomes constant depends on various factors shown here, which are the area of the nozzle, the area of the compensator and the height between the nozzle and the connecting channel. At exceedingly low suctions, the fuel drops in the well, then a suction is soon reached at which the air passes through the channel to the main nozzle, and from that time on the flow through the compensating orifice is practically constant. As I said, the suction at which this constancy is reached depends on the instrument. In the instrument, such as our company makes, this constancy of flow is reached for a much lower suction than 2 in. of water, and the fair average would be 1.1 in. of water, so that we have there one reason why it is legitimate to continue the curve of quality of the main compensated jet nearer toward the origin of co-ordinates.

When Throttle Is Wide Open

There is another reason why it can be continued still further. There is a statement in the paper, which I will read: "When the throttle is wide open and the motor is slowed down by additional load, the decreasing suction of the motor permits the atmospheric well to fill gradually with gasoline, thus decreasing the gravity head in the float chamber and causing the quantity discharged into the well to decrease."

It would seem that way, but it is not correct. This is a peculiar point, which is hardly known outside of our own organization, and I don't wonder that an error can be made. After the suction is reached, we have no gasoline in channel but an emulsion, but it is much lighter than gasoline, and it would take a good deal less suction to hold it up and carry it up, so that if the critical suction is 1.1 of water, going up, it doesn't follow that the well will again fill up when this suction of 1.1 of water is reached, going down; this kind of hysteresis effect causes the flow from the compensating jet to remain constant for suctions much lower than have evidently been assumed.

Summing Up

To sum up, I have taken the premises under which this theoretical analysis has been made, and have shown that, by simply changing parameters, which is equivalent to changing the sizes of the jets, I arrive at results quite different.

There is, therefore, a question in my mind as to whether or not, by following exactly the same course, changing the jets, it would not have been possible, when operating with the actual carbureter, to obtain, likewise, entirely different and much more satisfactory results.

I am not questioning the accuracy of the curves. I am not questioning that at all. I do adopt, for purposes of argument, the theories that were evolved from the facts and from these theories, as well as from the fact, I have deduced what the facts would have been if a larger nozzle had been chosen. This is quite different. I am taking the very premises that are presupposed by both curves. I have taken those premises, and by choosing the parabola, or, in other words, by choosing the size of the opening, and the amount of constant flow, I have obtained this curve. We know by experience that this is what is done in a practical fitting of a carbureter to an engine. When you change those jets, those curves are changed.

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Cleveland Gets Cars by Water

Ninety cars worth $65,560 *were shipped by water May* 6, *by the Willys-Overland Co. to Cleveland on the steamer City of Buffalo, establishing a new record for automobile shipments.*

The Willys-Overland, Inc., of Cleveland, uncertain as to whether it would receive its spring shipments of cars in proper time, owing to a shortage of freight cars, decided on this procedure to get prompt delivery.

The City of Buffalo left Cleveland Friday evening and reached Toledo Saturday morning at 10 *a. m. At* 10.30 *the City of Buffalo moved forward to the dock and the cars were run on board. Less than two hours later the ship was steaming down the river. The boat reached Cleveland that evening and was met by a hundred drivers.*

Automobiling Hard Hit in England

Touring Car Importation Prohibited, Gasoline Taxed 12 Cents Per Gallon and Triple Car Taxes with Strict Driving Regulations—Contrasting Situation in France

By W. F. Bradley

LONDON, ENGLAND, April 20—With the importation of touring cars prohibited, a tax of 12 cents per gallon on gasoline, no benzol supplies, and a proposal which will almost certainly become law to triple present taxes, the position of British motorists is not at all enviable, Further, there is an active campaign against what is termed pleasure motoring, quite an appreciable amount of money having been spent in posters and other printed matter asking motorists not to use cars for purposes of pleasure. As a matter of fact, automobiles have been very little used during the last six months for anything but utilitarian purposes, the high cost of gasoline and the all-around increased cost of living being quite sufficient to eliminate motoring for pleasure. Nevertheless, the effect of the official appeal has been to create an impression in the minds of the public that car owners are squandering money which ought to be kept in the country and used for more useful purposes.

$1,000,000 in Taxes

The new taxation proposals are a very severe blow. It is officially announced that $1,000,000 will be gathered in by means of these taxes, but as owners have the facility of storing their cars and thus avoiding the payment of the taxes, it is quite possible that the taxable material will disappear and that the object of the government will be defeated. This danger is so great that many are inclined to believe the taxes have been levied with a view to suppressing motoring rather than to getting additional revenue.

Up to 16 hp. taxes are doubled; from 16 hp. and upwards they are trebled. The method of calculating horsepower is on cylinder bore only. A four-cylinder car of 2 11/16 in. bore is less than 12 hp. and normally pays an annual tax of $15; up to 3 5/32 in. bore is less than 16 hp. and pays $20 tax. Up to 4-in. bore cars are rated at less than 26 hp. and are normally taxed $30. While in the two lower classes the taxes are doubled, in the third and all higher classes the tax is trebled. This strikes particularly hard at all the cheaper American cars, for with the exception of the Overland model 75 and the small Saxon these come into the third or higher classes and have to bear treble taxes. The Ford, which is in a numerical superiority in England, has to bear a triple tax. The following table shows the original and the new taxation on some of the leading American cars on the British market:

Car	Original Tax	New Tax
Ford	$30	$90
Overland 6-cyl.	40	120
Overland 83	40	120
Overland 75	20	40
Dodge	30	90
Buick D-54, 6	50	150
Buick D-44, 6	30	90
Studebaker, 4-40	30	90
Studebaker, 6-50	50	150
White, G. A. H.	30	90
White, G. E. D.	40	120
Saxon, 14-15	20	40
Saxon S-2	30	90
Saxon 17	30	90
Pierce 66 A-4	100	300
Packard 12-cyl.	100	300

Old type cars of any make, the value of which is now very low, are so highly taxed that it is practically impossible for their owners to run them. There must be hundreds of old-type Panhards, Charrons, Mercedes, De Dion, and other established makes, the value of which is less than $300, but which on account of their big cylinder bore have a high-rated horsepower and are taxed $90 to $150. Under the English law if a car is not in use it does not pay taxes, thus it is quite likely that many owners will prefer to store their cars at the end of June and avoid paying the increased duty. In these cases the State will lose not only the car tax, but also the gasoline and the annual driving tax. In drawing up the budget it appears to have been assumed that cars of 16 hp. and above are all costly vehicles belonging to wealthy persons.

Horsepower Inequalities

The fact has been overlooked that the horsepower rating is quite an arbitrary one, and that many a small bore, long stroke, high-speed European motor has a bigger cylinder capacity and develops greater power than a big bore short stroke American car. As an instance, the 3.1 by 7.08 in. Hispano-Suiza is only rated at 15.9 hp., and will pay a $40 tax, while a 3¾ by 4-in. Ford, which develops less than half the power and costs a third of the price of the French car, is rated at 22.4 hp. and has to pay a $90 tax. Scores of such examples could be quoted to show the illogical nature of the new taxation.

Automobile dealers are very hard hit. There are very few English cars available for the market, and all agents have in consequence been glad to take up agencies for American cars. Now that this source of supply is shut off, nothing remains for dealers but to close their stores. Many of the smaller dealers who were unable to get American business closed months ago, but the larger firms have managed to keep going until the present. Now such big firms as the Fiat company and the Renault branch have decided to close their doors. The value of used cars, particularly small models and modern types, is strengthening; big, old type cars have lost in value.

Few Restrictions in France

Reports, which were prevalent a few weeks ago, of the Government control of gasoline, which would only be given out to those persons who could show a valid reason for motoring, are now receiving little attention. The prohibition of imports, the increased taxation and the high cost of gasoline are doubtless sufficiently restrictive measures. Motorists are still receiving very close attention in the matter of lighting regulations, headlights being forbidden in practically the whole of England and only feeble sidelights being permissible in most of the coastal area.

Motoring conditions in France contrast strangely with those of England. In a country where the war is being decided there are, outside the army zone, practically no restrictions on the use of automobiles. Unlike England, lighting regulations have undergone no change; automobile taxation has not been increased, although a rise is promised for im-

mediately after the war; the gasoline tax remains as before the war, although high freights and other causes have sent the price of fuel up nearly 40 per cent. All motorists must register monthly with the police, but this measure is intended to weed out undesirables and not to restrict the use of cars. The whole of the army zone is rigorously and unconditionally closed to civilian motorists, but in the remainder of French territory it is possible to use a car with as much freedom as in peace times.

Very few factories are producing cars for private consumption, although there are rumors that a few of the leading firms will shortly get a release from army orders permitting them to build for private customers. Too much importance must not be attached to this, for in very many cases the automobile factories are now so efficiently organized for the production of shells and other war material that it is more profitable to continue on the present work than to build cars for private use. During the last twelve months some of the biggest factories have been so completely converted and so thoroughly equipped for shell production that it would be unprofitable to build cars. The only advantage of car orders is that in some cases it enables old stock to be used up which could not be employed in normal and more critical times.

Demand for Cars and Trucks

A certain demand has sprung up during the past few months for both touring cars and trucks of American construction. The touring car demand is almost entirely dependent on military requisitions. If the army authorities visit a certain district and requisition the private cars to be found there, that district immediately becomes a buyer of American cars. There are now very fews cars in France not indispensable to their owners. Thus, if the army steps in and purchases the cars, paying cash for them, the motorist immediately becomes a purchaser of an American car.

Seeing that the net result of the requisitions is to increase the sales of American cars, the agents for these cars have endeavored to sell direct to the army. In this way the army would get American cars instead of the private motorist, and the latter would not be subjected to any loss and inconvenience. While the army is quite willing to examine all offers made, and will cause sample cars to be stripped so that all details can be examined, there does not appear to be a single case of an order having been placed. About 1000 ¾-ton Jeffery trucks were ordered recently for ambulance service, but not a single order appears to have been placed for American touring cars for general army work. It is certain that no orders can be got direct out of Paris, and if any business were done it would go through the buying commission in New York.

American Firms in France

The American firms now doing touring car business in France are Ford, who easily heads the list, Buick, Overland, Dodge, Chevrolet, Maxwell, Mitchell and Saxon. It is understood that H. B. White, who has been Ford European representative for a number of years, will shortly return to America, and that Mr. Perry, the present English manager, will take charge of Europe, with an independent company for France. It is also known that Ford will erect big factories near Southampton, producing there for the whole European market. This would free the cars from any import duties which may be imposed, for it is practically certain that there will be some preferential tariff among the Allies after the war. Another feature of this ever-changing problem is the high taxation which falls on American cars by reason of the European system of determining horsepower by bore alone. If this present system of taxation is continued it is likely to have a serious effect on the sale of American cars.

The Buick is being very vigorously handled by a former Delage sales manager. Overland is in the hands of M. Falconnet, one of the oldest members of the French automobile industry, with very fine quarters in the Avenue Malakoff near the Etoile and Avenue de la Grande Armee. Dodge is placed on the market by Gaston, Williams & Wigmore, the Goode Brothers, formerly in charge of Packard interests, looking after the automobile section of this firm. The other American firms are doing a lesser volume of business; the attempt to put the Chalmers car on the market has not been followed up. Fairly high prices are being asked and obtained for American cars. Ford prices have been increased $200 in order to cover higher freight and increased rate of exchange. The two Buick six-cylinder models are being sold at $2,100 and $3,000 respectively. The Overland models are $1,640 and $1,860 each. The Dodge is sold at $1,600.

Up to the present there has been no increase in the import duties on foreign automobiles, the rate being about 8 per cent of the value of the car. It is well-known, however, that French manufacturers are determined to defend their interests, and that they are working for a higher tariff. Reports are circulated in the trade that there will very shortly be a duty of more than 50 per cent on foreign automobiles, or a total prohibition of imports. The probabilities are that prohibition will be preferred at the present time to an increase in duty; it is certain that a tariff as high as 50 per cent will not be adopted. The arguments in favor of prohibition are the example set by England, the necessity of releasing freight for more necessary articles, and also of getting monetary exchange back to a more favorable rate.

The French Industry

The French automobile industry is a wonderfully organized section of the munitions department. There is not a factory but has increased either its ground area or its plant, or both. In the big factories the increase runs as high as 60 per cent. In the small shops the value has gone up not less than 200 per cent. Among these latter are garages and small repair shops which before the war possessed a lathe and a drilling machine, but which are now very finely equipped machine shops capable of doing the best and most economical work. There is a strong tendency to invest profits in additional plant and factory improvements for the future, rather than show a high profit now.

Not a few manufacturers are asking what they will do with their enlarged and improved factories when the war is over. In practically all cases the original cost of the plant has been wiped off by war contracts, but work must still be found for it. The future is so uncertain that it is a most difficult matter for any manufacturer to decide what set of conditions he will have to meet and to prepare to meet those conditions.

It is evident that Allied automobile manufacturers will make a determined stand against foreign competition. All kinds of schemes are suggested, and while many of them have not and never will get beyond the talking stage, it is evident that common action is in contemplation. According to one well authenticated report a group of Allied manufacturers, small in number but representing powerful interests, will arrange to build in their respective factories a uniform type of cheap popular car on American lines to be sold at home and abroad at a price which will eliminate the American car of the same class. These cars will differ only in the names they bear. There will be a clearing house, so that a shortage of any one make can be met by the other firms, and profits from these sales will be pooled. It is impossible to say what chances, if any, this scheme has of being put into execution. It is certain, however, that at least one powerful European firm has already produced a popular after-the-war-model on American lines with the single exception that the motor dimensions are better adapted to European taxation conditions than are the dimensions of the average American engine.

The History of the Pneumatic Tire—2

Early History of Rubber—First Mentioned in 1525 as Used by Natives in Mexico—Early European Experiments—Early Making of Waterproof Fabrics

The History of the American Automobile Industry—29

By David Beecroft

THE modern automobile tire is so completely a thing of rubber and the automobile is so dependent upon its tire, without which many people think it could not have proved successful, that it seems necessary to begin with a history of rubber itself. Rubber, while largely an American product, is found in all the tropical countries of the world and is the product of a great many plants. The best rubber, however, is from a South American tree, which has, in recent years, been introduced into many of the tropical countries, so that a large amount of our modern rubber comes from rubber plantations of recent growth, a majority of our rubber coming from the plantations of the Straits Settlements in the East.

Rubber First Mentioned in 1525

The first mention of rubber dates back to 1525, when certain Spaniards in Mexico saw the natives playing with balls of a noticeable elasticity. They bounced more than did balls with which the Spaniards were acquainted. In 1536, Orviedo y Valdas, in his history, described articles made from the coagulated latex of the rubber tree by the Amazonian Indians. They not only made balls and flexible jugs, like horn bulbs or syringe bulbs, but also made boots and waterproofed their fabrics with it. The jugs or bulbs were made by dipping a clay form into the juice and letting it coagulate, often assisted by smoking over a fire. When a sufficient thickness was obtained, the clay form was broken so that it could be taken out through the narrow neck. They also fitted tubes to these bulbs and used them for various purposes, the tubes being hollow reeds or bamboos.

Its Use in South America

Two hundred years later, in 1725, the French government sent La Condamine to South America in charge of a scientific expedition, and he sent a small quantity of rubber to Paris and described its uses as he found them in South America at that time. It had been brought to Europe before that time or about the beginning of that century, but neither its origin nor nature seemed to be known. In 1751, Fresneau described the rubber tree and how the natives obtained the material. This is done by cutting into the bark of the tree and catching the juice which exudes or flows therefrom. The name, Caoutchouc, comes from the original native name which implied that the juice exuded. Small pieces of coagulated juice may often be picked from the trees, and frequently cups were cut into the bark which collected the juice, but more commonly, the method is to catch the juice as the sap of the maple is caught for producing maple sugar. Rubber is not, however, a sap, and is not found in the body of the tree, but in the bark. It differs widely from gutta percha.

Early Experiments in Europe

Two French chemists, Herissant and Macquer, communicated to the Paris Academy, in 1768, the results of their experiments, showing that India rubber is soluble in oil of turpentine and in pure ether, but no commercial use seems to have been made of this knowledge in the next twenty years. From 1791 to 1815, several people prepared garments by the use of rubber solutions. In 1820 Nadier cut it into threads and made tissues of these. In 1770 Priestly suggested its use as an eraser for pencil marks, but in those days there were practically no pencils and therefore very little use for erasers. Its common name, however, comes from this use.

Benzine as a Solvent

The first industrial application worthy of the name seems to have been that of Macintosh of Manchester, England, who, in 1823, or possibly a little earlier, found that rubber would dissolve in benzine, a fairly cheap solvent, and who began making waterproof fabrics, to many forms of which his name still attaches. In 1832, the Roxbury India Rubber Co. was formed in Massachusetts to engage in this work and Charles Goodyear was one of its employees. In the same year, both Hayward in England, and Luedersdorf in Germany, independently used sulphur to prevent adhesion of rubber articles to each other. It does not appear that either of them recognized any vulcanizing or curing effect, however, as no mention of their doing so is made in any of the references to their work as recorded at that time. This discovery was reserved until three years later when Goodyear attained the first knowledge of such possibilities. His early work in this direction and its results will be taken up next week.

The FORVM

HABIT IN AUTOMOBILE CONSTRUCTION KILLS PROGRESS OR IMPROVEMENT—THE STEERING FACTOR IN THE DIFFERENTIAL PROBLEM—MORE CYLINDERS AND COMPLICATION—TWO ENGINES

Two Engines as Solution of Differential Problem

By W. J. P. Moore

YOUR article in THE AUTOMOBILE for April 13 on the suggested Abandonment of the Differential, like your article of Sept. 2, 1915, on Improving the Steering is a most important one, and should attract considerable attention, and discussion in regard to this rather complicated and expensive, and apparently useless, mechanism of automobile construction. It seems to point the way to important improvements, that are possible and is quite in line with the advanced ideas you have put forward, and advocated with a number of your articles that have appeared from time to time.

Some of these articles, however, do not appear to have attracted the attention their importance justified, at least so far as discussion of them in your journal indicates, although they may have taken deeper root than thus appears and set many thinking and scheming.

There is a saying, "Force of habit beats competition," and it would almost seem that, so far as many things that go into the construction of the present day automobile are concerned, this might be modified to, "Force of habit in the construction of automobiles kills progress or improvement."

Your illustration of the motor truck axle without a differential may show one way that it can be done, but is not this way of doing it a step in the wrong direction and accomplished at a great sacrifice of power and efficiency?

This seems like going right back to the old car axle type mentioned in the beginning of your article, which appears to be the most inefficient form of axle known, and in which there has been no improvement or progress made since the early ages and it does not seem probable that we will get anywhere by following such obsolete and out of date practice.

Railroad Car Axles Crude

There is nothing in the history of development of railroading to show that any serious attention has ever been given to increase efficiency or reduce the power required to handle a given trainload, but that all their attention has been given to increasing size of load to be handled by merely increasing the power of locomotives, size of cars and weight of rails necessary for these increased loads.

Some day, and it does not seem to be very far off, they will reach their limit of power for their locomotives, and the strength of rail required to carry them, and will be compelled to give consideration to efficiency and abandon their crude axles, for a more efficient form and then the locomotive of the future to draw equal size loads will compare with the locomotive of the present day about as a Ford compares with a Packard twelve, and with these improvements will come cheap transportation. Also they will be compelled to see the "self tracking tractor train" of the motor truck and take a lesson from this and learn how to pull their trains in the direction of least resistance. How long a tractor train would a motor truck haul (even on rails with flanged wheels) when pulled by the body of tractors and the wheels unguided except by grinding on the flanges as guides? Now with the one-wheel-drive motor truck without differential that you illustrate, you are driving always in one direction, straight ahead, and steering in many directions and never are these forces in unison except when moving in a straight line, hence loss of power and efficiency. This is admitted by your article, for you say that this motor omnibus required more throttle opening and was sluggish in making turns.

Further with a motor truck all these turns would be made at a much more moderate speed than with an automobile, and the amount of throttle opening would correspondingly increase as well as the sluggishness. Moreover, on slightly greasy or wet pavements the skidding of the front wheels would be greatly increased and danger of accidents be much greater.

You do not say how much harder it was for the driver to steer, but this must have been considerable on a heavy motor omnibus, and certainly would perhaps be even a greater factor in lighter and higher speed automobiles.

Decreasing the Spinning

As regards the apparently lesser tire wear mentioned, this improvement undoubtedly is accounted for by the "spinning" being decreased, which of course is the cause of the greatest wear in all tires. If spinning were practically eliminated probably the wear on the tire would be halved or say its life doubled. In this respect at least the differentialless axle marks an improvement and undoubtedly should tend to equalize the life of the front and rear tires and increase their life.

Is not your assumption as stated in the concluding paragraph of 99 per cent normal (straight) running rather high? Straight roads are few and far between, bends and corners very numerous, not to mention turnouts to be made and holes and obstructions to be avoided. It would be interesting to have, say, a day's record of the motor bus you mention showing the various turns and the degrees of each movement of the wheel, and probably this ratio would be nearer 3 to 1 than 99 to 1, for no matter how small the angle, the increased power factor and decreased efficiency would enter into it. However, that there are many advantages to be gained by a differentialless axle cannot be denied, and these are pointed out very thoroughly in your article, and the real question is how is the best way of accomplishing this.

Two Differential Drives

At the present time there are only two forms of drive axles with differential in extensive use, either for automobiles or motor trucks.

A—Single axle drive with differential.

B—Two axle drive with differential.

or the so-called "four-wheel-drive," and both having the same inherent defects due solely to the differential, namely:

Axle A—If either wheel lacks traction you are at a standstill and down and out.

Axle B—If either wheel on the front axle lacks traction you have, of course, still the other axle to drive the same as in A. This is not a four-wheel drive in reality, but rather a double two-wheel-drive and it is impossible to get a real four-wheel-drive and have a differential, as your driving wheels go out of commission by twos instead of singly. Of course the advantages of the two-axle-drives are not questioned, neither must the complications of this form of construction be overlooked. Probably the latter type of axle will never come into use in automobile construction and how long its use will be justified in truck construction is perhaps problematic.

Other Forms of Drive

Now your article on a differentialless axle shows how this can be done in the type of motor truck axle indicated, namely:

Axle C—A *single* two-wheel-drive without differential, but beyond this there is still another form of drive which you do not mention and which it seems should not be lost sight of, namely:

Axle D—A *double* two-wheel-drive having two bevel gears and pinions without differential, or a real two-wheel-drive, each wheel driven independently by separate dual or twin motors.

This latter form of axle seems to combine all the desirable features of the differential axle, without its disadvantages; and also to be free from the defects of the differentialless axle C, you mention.

The points of superiority of Axle D seem to be:

1. Unless *both* driven wheels are tractionless you are not at a standstill.

2. It gives you all the advantages of the so called four-wheel-drive without any of its complications for two wheels must be tractionless before you are at a standstill.

3. Your power and efficiency is maintained under all conditions of turning, for you can drive in the direction you are turning.

The Steering Problem

4. Steering is easier and almost a negligible factor as you drive around a corner or bend, the steering and driving practically timing together.

5. With a castor type of three-wheel truck like the Knox tractor, all steering could be eliminated and the machine be entirely manipulated by driving only provided that suitable means are adopted for driving one of the drive wheels faster than the other by proper controls. The same thing would be possible with any four-wheel machine having the steering knuckle in the center of the rotation plane of the wheel and of the castor type as advocated in your article of Sept. 2, 1915, referred to above.

6. With either of the forms referred to in 5 above, the steering gear could either be done away with entirely or used only as an auxiliary or secondary, and the irreversibility of the steering gear now so necessary, dispensed with and therefore much cheapened.

7. The power exerted to drive each wheel would be in proportion to the power required and the maximum of efficiency be maintained under all conditions of service and especially on curves.

Complications Are Increasing

8. The above results can undoubtedly be accomplished with less complication and fewer parts than with the present forms of twelve-cylinder engines (not to mention the sixteen or more cylinders we hear talked of) with their gearboxes, change speed gears, differentials, etc. Some of these machines have enormous power as for instance the Packard twelve which by published reports admits to 122 hp. under test and probably is equalled also under maximum working conditions on the roads or in speed tests as at Sheepshead Bay speedway. Probably also other of twelve-cylinder cars are equally powerful although no authentic published reports have appeared.

In fact an examination into what is being done by some of the important makers tends to show that size, complication and weight are continually increasing and there appears to be no limit they are prepared to go to in order that certain results may be obtained.

Such being the case, there has probably never been a time in the history of automobile construction that any modification or improvement that may be advocated would receive the attention that it would at this time.

Why Not Use Two Engines?

9. Assuming the driving power to be gasoline engines, twin fours or twin sixes would replace the V eights and twelves, the complication in the engines themselves would not vary materially and would be more than offset by the fact that it would be possible to do away entirely with gearbox and change speeds provided the size of the power units was anything like those now so extensively advocated and used in the present forms of construction or even with smaller units for that matter. All that is required is a type of clutch that can be slipped in starting and under other adverse conditions and it would appear to be an easy trick to arrange to water-cool the clutch if found necessary.

10. As it might be difficult to reverse the gasoline engines, that could be easily accomplished in the rear axle, this providing for forward motion and reverse as well as a neutral.

11. The various speeds of the gasoline engines could be controlled by a single throttle lever located on the steering wheel in the usual manner and so adjusted that when the steering wheel is in its central position and the car going straight ahead, each carbureter valve is opened and closed in unison, but when the wheel in steering is turned in either direction, the outside carbureter be automatically given a slightly greater opening and the inside one slightly closed, thus driving the outer driving wheel at an increased speed and reducing the speed of the inner driving wheel.

It seems as though this would make an ideal racing car for circular speedways, and give the maximum of power and efficiency on the curves and be able to beat out any car of its inches or displacement ever designed; for on a track like the Sheepshead Bay speedway, as one half the distance is on a curve, therefore the racing car as now constructed it is inefficient at least half the time.

Perhaps this also may account in part for the Sunbeam car mentioned in your article reverting to a differential as it would seem that with the increase of speedway racing the differential type as compared with the differentialless car as ordinarily constructed would have an advantage.

Undoubtedly there are other forms of differentialless axles that will be suggested to others by your article.

Comfort and Body Weight—Cylinders and Economy

By Chas. E. Duryea,
Consulting Engineer

PERMIT me to protest against Mr. Watts' paragraph in THE AUTOMOBILE for April 27, in which he classes cars as those of toleration weighing below 1800, those of comfort weighing from 1800 to 3000 lb. and those of luxury weighing above that. True, he qualifies this statement by saying that "there are notable exceptions," but does not say how they are obtained and leaves the matter based on the idea that his preceding paragraph covers it. That the ratio of sprung to unsprung weight and the ratio of sprung weight to passenger weight are the controlling factors in determining

passenger comfort, although he has "never seen any mathematical proof," is, it seems to me, wholly unwarranted.

Any farmer boy who has jolted to town with a basket of eggs nestling in a small pile of straw on the floor of a springless farm wagon weighing nearly a ton has ideas different from these, and farmers are buying many cars these days. That same farmer boy finds the light spring seat he uses made with four hickory sticks for springs and no cushion at all fairly comfortable, although both he and the seat may not together weigh 100 lb., and although the floor of the wagon is bouncing so badly that his feet are actually suffering. This is no fanciful picture. I was that boy. Further, most of my automobiles have been well below the 1800-lb. figure and a number of them—some as light as 500-lb. total—have carried the power plant complete on a frame which rested at one end on the rear axle. Some of this construction have used solid tires. So if experience is worth anything, and most people prefer it to theory, I can assure Mr. Watts and your readers that light cars exist which are more comfortable than many cars of two to four times their weight. Comfort is secured by using springs proportionate to the load; by avoiding synchronous vibrations; by proper hanging of the body so as to permit the wheels to toss from side to side without greatly affecting the body and by again cushioning the riders so that body movements of short amplitude do not largely reach them. I do not believe that light passengers find a heavy-bodied car easier riding than do heavy passengers, but rather the reverse. For comfort passengers should be carried between the wheels and not over them and should be carried low so as to avoid the sidewise rocking. One's body does not well resist sidewise rocking. There are many factors affecting comfort and users should not assume that they cannot have comfort in a light car. The glass bead on the tip of the feather on milady's hat may do much moving about, but it is comfortable and runs no risk of being broken.

The Cylinder Question

Mr. Watts very properly sets forth the falsity of the idea that many engine cylinders are necessary for comfort when he says the engine impulses are absorbed in the flywheel. But even if the car is run at such low speeds that engine impulses are felt it is possible to kill them by introducing an elastic propeller shaft. Or if there is no slack between the engine and the wheels, and therefore no chance for the car to overrun the engine and then get a jerk when the impulse speeds up the flywheel, the engine impulses disappear. In fact, it is hard to imagine a sweeter application of power than the pressure of gases against a piston.

Since, however, most drive mechanisms are far from perfect, the number of cylinders must be considered. The single-cylinder need not be considered, because it cannot be mechanically and explosively balanced as can two or more. Most people judge the number of cylinders by the frequency of the exhaust and with muffled ears cannot tell whether the car has two or twelve cylinders. It is certainly folly to waste fuel that others need on inefficient many-cylindered motors when such is the case. Try it yourself. But do not compare an 1896 two-cylinder motor with a high-priced twelve-cylinder of 1916. Motors of all kinds have improved in twenty years. In fact, this is the answer. Automobiles are better to-day than last year in many respects and the difference in cylinder numbers is not the great factor it is credited with being.

Mr. Stratford's able article in THE AUTOMOBILE for April 20 very properly shows the necessity for filtering the air the motor breathes and he also points out the temperature losses which are a most potent factor in gasoline consumption. Why people complain of fuel costs and buy smaller and smaller water-cooled cylinders I cannot understand.

Mr. Laycock's no-differential argument should be read by everyone, although I cannot favor rigidly-connected rear wheels. The well known form of differential cannot leave us too quickly.

Mr. LeGare seems to think that a magneto jumps more than one plug gap at a time. I know of no warrant for this. The magneto spark is of much lower voltage and burns the points more rapidly, so several are provided that the gap may not burn too wide for the low voltage to jump. The battery and coil system does not use such a metal carrying current and so does not need to provide protection from wide gaps.

Your remarks on the constant pressure cycle are interesting. Professor Lucke has claimed that the Brayton cycle is as economical as the Rochas if properly built, but it certainly is not so easy to secure this theoretic economy. It seems to me that the gas turbine holds much promise for the near future and could easily be developed to the low efficiencies of the modern water-cooled multi-cylinder automobile engine. Your readers would appreciate information on this motor.

Thinks M. & S. Differential Near Ideal

By G. W. Smith

Chief Engineer Thos. B. Jeffery Co.

REGARDING the article dealing with the elimination of differentials, we have not conducted any direct experiments in this matter other than those having to do with the elimination of the differential from the transmission of the quad. I have no doubt that somewhat the same conditions are obtained here as in the conventional rear axle. It is certain, however, that the effects are much smaller and we have experienced no difficulty whatever although the differential has appeared in but one of our quad trucks.

I am inclined to think that the elimination of the differential from the touring car is not feasible on account of the short turning radius and the comparatively short wheelbase of most touring cars. The greatest difficulty to be met with would be the tendency of the rear axle shaft to twist and it is quite certain that these shafts would have to be approximately twice the strength of the present shaft to resist this continued action.

On the other hand I believe the differential could be dispensed with on cars having comparatively long turning radius and operated so as to favor the device to some extent. In other words the operator would be expected to make long turns at corners and other places, thus avoiding the great difference of tire travel in the outer and inner tires in a short length of travel.

It is my opinion that we have by far the best solution of this matter in the M. & S. differential and I feel that ultimately such a differential will be used on a majority of touring cars, thus avoiding any of the disagreeable features I have named above.

The Light Car Handbook

The publishing house of Iliffe & Sons, Ltd., 20 Tudor Street, London, E.C., England, in addition to producing *The Autocar* and several other British trade papers, is also responsible for a number of books on automobile subjects. The latest edition to its library is the Light Car Handbook, which has been produced for the instruction of owners of small cars. Although written with particular regard to a class of machine practically unknown in America, the book contains very clear explanations or a great many things applying to cars of every size.

It is profusely illustrated, contains very good instructions concerning care for the various parts of a car. It is a book which the earnest student of automobiles would be interested to possess. The price is 36 cents, or 48 cents prepaid.

The Rostrum

Unsprung Weight and Tire Wear

EDITOR THE AUTOMOBILE:—In various articles in THE AUTOMOBILE appearing from time to time, mention has been made of the subject of unsprung weight in connection with rear axle construction. I have failed to note any general discussion of the subject, however, and would like to learn more about the evil effects of much weight as applying particularly to the rear axle assembly. Is this effect confined to the matter of strength of rear axle housing or does it also cut quite a figure in wear and tear on rear tires?

How does it work out in the case of the electric vehicles having the driving motor actually inclosed in the rear axle housing?

Cincinnati, Ohio. H. G. C.

—It is generally conceded that the ratio of unsprung to sprung weight is of great importance in its effect on tire wear. The entire matter is one of common sense. It is quite apparent that if a car weighs a given amount the best results and the longest life of working parts will be secured if the greatest possible portion of this weight is cushioned by suitable spring action. On the other hand, it is necessary to increase the unsprung weight to hold the car on the ground and to take care of other features of design. Therefore, the best ratio of sprung to unsprung weight is always a compromise. It may be generally said, however, that in ordinary passenger car practice the efforts are on the side of reduction rather than increasing the relative unsprung weight.

Ideas on Body Design

Editor THE AUTOMOBILE:—I have read with great interest and also studied the body articles as appearing in THE AUTOMOBILE, especially so the one you published in the Feb. 3, issue entitled, Driver's Lot 99 Per Cent Discomfort. I wish to make a few remarks and will start at the diagram showing a section through a touring body on page 217. The steering wheel is fixed by *A*, *B* and *E*, as in Fig. 1. The rim of a wheel being 1 in. will determine the angle α of the wheel for different diameters of wheel; viz., 16 in., 17 in. and 18 in. as in Fig. 1.

$$\text{rim } (90 \text{ deg.} - \alpha) = \frac{3.5 \text{ in.}}{8} = 0.437 \text{ for 16 in.}$$

$$\frac{3.5 \text{ in.}}{8.5} = 0.412 \text{ for 17 in.}$$

$$\frac{3.5 \text{ in.}}{9} = 0.388 \text{ for 18 in. wheel.}$$

angle (90 deg. — α) for 16 in. diameter wheel is 25 deg. — 55;
$\alpha_{16} = 64$ deg. — 5
17 in. diameter wheel is 24 deg. — 20;
$\alpha_{17} = 65$ deg. — 40
18 in. diameter wheel is 22 deg. — 50;
$\alpha_{18} = 67$ deg. — 10

I just want to call attention to these angles as compared with what actually exist to-day on cars made. By checking up the same way over the table you have compiled from nineteen makes of cars you will soon see the fact that the angle α is between 45 deg. and 30 deg. and not as recommended in your article, 64 deg. to 67 deg., according to wheel diameter. I think the angle α should be included in the tables instead of the dimension E.

An important thing left off is the height of the sides and the height of the seat back. Also the distance from dash to front seat. Dimension *S* is given in such a way that it is difficult to say what is meant. Is it measured down at the floor, at the narrowest point between rear seat top and front seat back, or how high up from the floor, Fig. 1.

Many dimensions may be arrived at and as you suggest 1 in. either way is important. The position of the front door is not given properly—neither depth of front seat nor how much the underside of steering wheel rim projects into seat.

I would suggest that a standard diagram of a body be prepared so that the dimensions are absolutely fixed and that this diagram be submitted to the different manufacturers for fitting out. The way you have set this thing going is very admirable from the viewpoint of an engineer and there is no doubt you deserve the highest credit for your timely arrangement and opening up of discussion along the lines of body detail. I understand your viewpoint fully when you in starting this do not go further into details than already done, and presume you have laid the dimensions out as shown in order to get criticism started.

Chicago, Ill. A. S.

Steam vs. Gas Engine Power

Editor THE AUTOMOBILE:—Kindly point out the fallacies in the argument of some people that an internal combustion

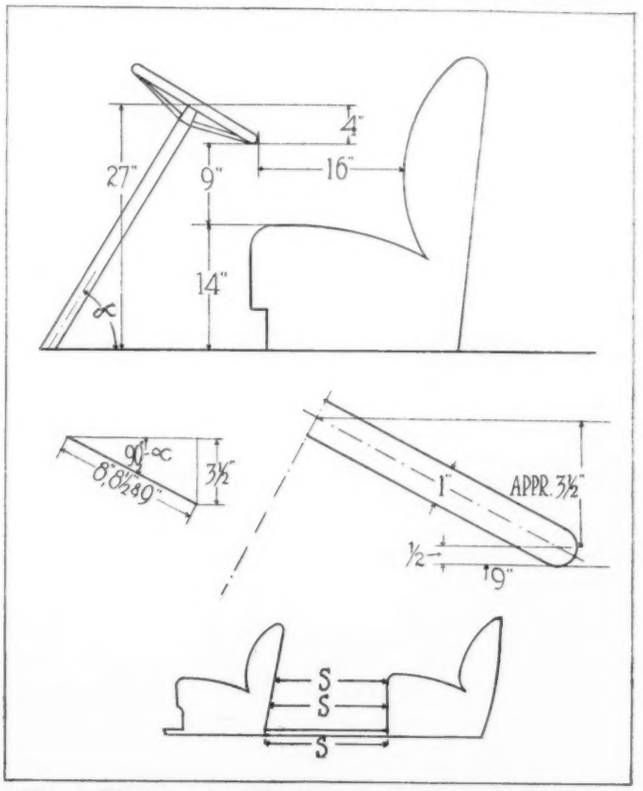


Fig. 1—Diagram of seating layout and arrangement of the steering wheel angle

motor of a given rated power has less real power than a steam engine of the same rated power.

2—Are not most of the high-grade stock motor cars of this country and Europe equipped with T or L-head motors?

3—With what type and location of valve has the highest efficiency on record been obtained in an automobile motor?

4—Has any change of much importance been made in motor or chassis design of the Pierce and Locomobile cars during the last six or seven years?

5—Has hydrogen gas ever been used as a fuel for internal combustion engines? If so, with what result?

Ithaca, N. Y. F. P. D.

—There are no fallacies in their arguments as they are correct. With a steam engine the steam can be admitted at much higher pressure, for instance, thereby giving much greater power than the normal rating.

2—L-head motors are in the majority.

3—We have no knowledge of any authentic efficiency record comparison.

4—No.

5—Yes, but owing to the fact that hydrogen gas is so expensive to make it is too costly for commercial use.

Wants To Enter Amateur Event

Editor THE AUTOMOBILE:—Herewith photograph of racing car which I am anxious to enter in some sort of a race. I am going to take this opportunity to ask if you will kindly advise us of any amateur races which are to be run this summer.

Kane, Pa. A. G. A.

—The only amateur drivers' race scheduled under A. A. A. sanction is for the Chicago speedway on May 20.

Changing Gear Ratio in Oakland

Editor THE AUTOMOBILE:—I have a 1912 Oakland 40. I have always used a 15-53 gear ratio in my rear construction. This ran with very little vibration to the car. I had plenty of power for what I needed, 90 per cent of my work being right in the city and flat country of Long Island. In making a change in my gears lately I was compelled to use a 13-53 ratio as there were no other gears in stock. On running the car I immediately noticed a great increase in vibration when running between 15 and 25 m.p.h. In fact, too much vibration for comfort. Now I am again contemplating a change in the gears and I want to know whether to leave the 13-53 and have the comfort of increased power plus vibration or to put in a 15-53 or even a 3 to 1 ratio.

2—I have a Bosch DU4 model 5 on the same car. While having new platinum points on the magneto we noticed that it gave a much hotter, fatter and yellower spark with the spark retarded and a thinner spark with it advanced. The repairman advised that I change the shoes on the magneto and reverse the spark conditions. He claimed untold increase in power would result after doing this.

Brooklyn, N. Y. B. G. G.

—You have changed your model 40, 1912 Oakland car from practically a 3½ to 1 gear ratio to a 4 to 1 gear ratio for the purpose of obtaining more power. Necessarily, in obtaining this additional power in a four-cylinder motor you got more vibration and there is no possible way to overcome this vibration, especially when running at a medium speed of from 15 to 25 m.p.h. If you desire to decrease vibration you can do so by going back to the old 3½ to 1 gear ratio or even to a 3 to 1 ratio, which would still further decrease the vibration, but if you leave the gear ratio at 4 to 1 you must expect this increased vibration unless your car is running at top speed.

2—The Bosch DU4 model 5 magneto is that model in which the overlap pole shoes are used. This construction provides a very efficient spark in the retarded position so that those engines having improper gas conditions can be started readily

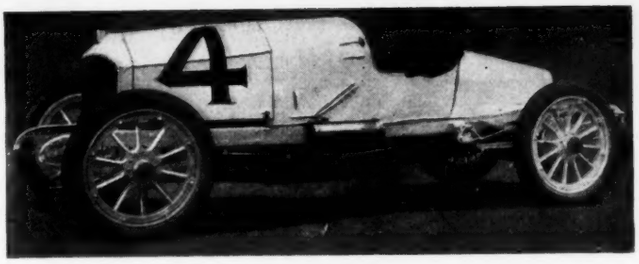


Fig. 2—Racing car reader wants to enter in amateur race

directly on the magneto. This construction does not provide a spark of equal intensity at low speed when the magneto is fully advanced, but the spark provided is more than sufficient for all-around efficiency. THE AUTOMOBILE would not advise experimenting with the pole shoes, as suggested, since it is advisable to take into consideration the individual characteristics of the motor. You will no doubt find that your motor will give satisfactory results with the magneto in its present condition. Undoubtedly you have had no difficulty in the past and we would advise no change.

Kerosene as a Carbon Remover

Editor THE AUTOMOBILE:—Will water remove carbon? If so would you advise running it through the carbureter? My car is equipped with a Stromberg. How much would you advise using? I have been told that it was a good idea to use 2 gal. of very hot water followed by a gallon of kerosene put through the carbureter in the same manner. What is your advice?

2—My car has force feed lubrication. Would it injure it to run the motor, say, for one minute, with kerosene in the crankcase instead of lubricating oil? This, of course, is with the idea of running out all the foul deposits.

Bessemer, Ala. L. M.

—There are a great many who believe very strongly in the use of water for carbon removing, and there is no doubt but that it assists in this respect to some extent. It would be better, however, not to introduce it into the carbureter but into the intake manifold between the carbureter and the cylinder. It should be allowed to enter in very minute quantities. The action which probably takes place is this: When the water enters the cylinder it is probably transformed into steam which cuts away the carbon binding substances in the cylinder.

2—It would probably do no harm to run the engine very slowly for only a minute. It would be inadvisable, however, to extend the period beyond this.

How Speedometers Operate

Editor THE AUTOMOBILE:—What makes the hand or dial of a speedometer move? Is it a governor or is it through a spring?

New York City. O. K.

—In fundamental principle there are four methods of operating the needle or dial on a speedometer. These are by magnetism, by centrifugal force, by air or by hydraulic drive.

The magnetic principle as indicated in Stewart-Warner and American Ever-Ready instruments, utilizes a revolving magnet positively driven from the car wheel or other part. The magnet exerts its influence on a metal part which is separated from it by an air gap and which in turn is connected with the indicating mechanism. The metal part is generally aluminum as the inertia of the part must be kept as low as possible to make the speedometer quickly sensible to speed changes. A feature of the magnetic design is that the travel of the dial bears a direct ratio to the speed of travel of the magnet, and in order to compensate for changes

in the drag due to temperature differences, a compensating unit is fitted.

Centrifugal control as utilized in speedometers is very much the same as that on a fly-ball engine governor. Standard, Johns-Manville, Sears-Cross, Corbin-Brown, Hoffeker and Garford use this principle. Weights are mounted on the revolving shaft by bell crank levers which allow them to travel further from the axis of the shaft as the speed of the drive increases. The centrifugal force of the weights increases as the square of the velocity of the shaft.

Weights Actuate Needle

This tendency of the weights to fly from the axial center of the shaft under the influence of centrifugal force furnishes the basis of the indicating needle movement. An ingenious feature in centrifugal design is that although the movement of the weights would naturally vary as the square of the speed, the levers or cams governing the movement are so calculated that calibrations on the dial are uniform or nearly so. Another feature which is carefully watched is the balance of the weights. The governors are made very sensitive so that even at low speeds the correct rate of travel may be indicated. Improvements in this direction have been made within a year by at least one of the centrifugal speedometer manufacturers.

The air principle is used only on one make, the Van Sicklen, in which a blast of air from a pump within the speedometer forms the source of operation of the indicator needle. As the speed of the drive increases the volume of air flow becomes greater, thereby increasing the travel of a pivoted dial, calibration of which is effected by governing the size of the passages through which the air flows.

One instrument, the Veeder, which employs the hydraulic system, uses a centrifugal pump which is connected with the drive and which lifts a liquid to a height proportional with the speed of the drive. The tube in which the colored liquid is lifted is calibrated to register speed.

Setting Camshaft On 1909 Rambler

Editor THE AUTOMOBILE:—What is the proper way of setting camshaft and is a model R Remy magneto suitable for a Rambler model 44 serial 20277 1909 car? If so how would you time same?

Sewalls Point, Va. G. S.

—In setting the camshaft proceed in the following manner: Set the number 4 piston on dead center and so place the camshaft that the cam that operates the exhaust valve on number 4 cylinder, which is the front cylinder on this car, is just leaving the roller. Then turn the motor with the crank until cam on number 4 cylinder is just coming onto the roller. At this point the mark on the flywheel should be on top even with the indicator. This mark should be the one which is about 7 in. ahead of the center mark on the flywheel. If this does not come even the remedy is obvious. Turn the camshaft one tooth at a time until you get the result as described above.

Not a Locked Differential

Editor THE AUTOMOBILE:—Kindly give sketch and description of the locked differential which I have seen so much about in your journal recently.

Dumbarton, Va. A. R. JOHNSON.

—If you will refer to THE AUTOMOBILE for April 13 on page 672, you will note that the matter which is being discussed is not some form of differential lock, but the abandonment of the differential altogether.

On that page appeared a drawing of the Sheldon worm-driven axle with a solid driveshaft replacing the differential. A number of tests on this type of axle have been made in this country lately and the Fifth Avenue Coach Co. has some buses running in New York City which are equipped with them. So far tests seem to show that, contrary to general expectations, tire wear has been decreased.

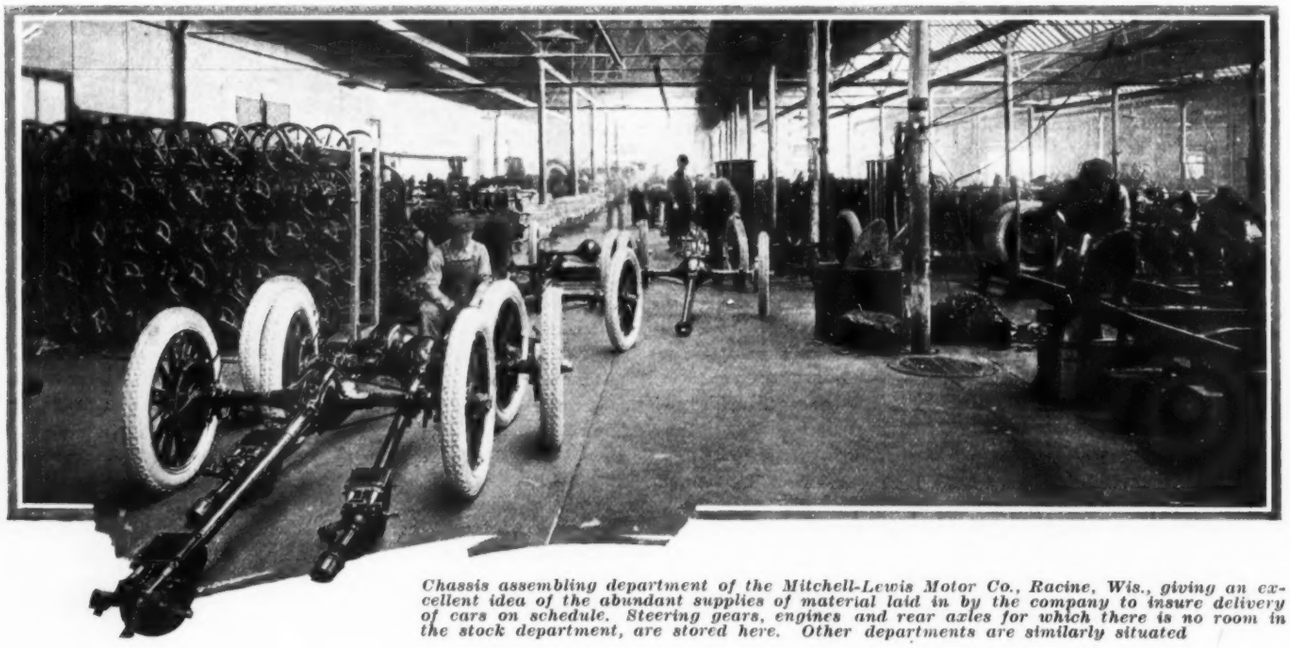
Must Decrease Compression Space

Editor THE AUTOMOBILE:—I have a motor 5½ by 6, T-head, 2¼ valves, 60 lb. compression. How much thickness will have to be added to piston heads to raise compression to 85 lb.?

West Milford, West Va. B. BROS.

—You will have to decrease the compression space to about three-quarters of its present volume.

Mitchell-Lewis Stock Rooms Are Overflowing

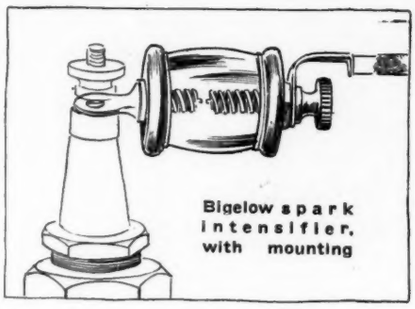


Chassis assembling department of the Mitchell-Lewis Motor Co., Racine, Wis., giving an excellent idea of the abundant supplies of material laid in by the company to insure delivery of cars on schedule. Steering gears, engines and rear axles for which there is no room in the stock department, are stored here. Other departments are similarly situated

ACCESSORIES

Bigelow Spark Intensifier

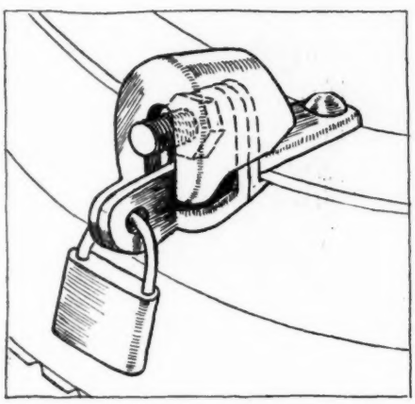
THIS little spark plug attachment, illustrated herewith, is attached by simply screwing on the spark plug binding post and to the wire terminal. By merely looking at this device the spark can be seen jumping the gap, so that spark plug trouble is readily detected. The barrel is made of magnifying glass, and this feature shows up the spark clearly, at night giving a glow like that of an electric light. The intensifier is claimed to overcome all spark plug troubles, making a plug fouled with grease, carbon or soot, or with a broken porcelain, fire perfectly. It is also claimed to intensify the current so that a hotter spark is given, increasing the engine power by 20 per cent and doing away with clouds of black smoke. It is claimed to increase the engine power by 20 per cent and to obviate the necessity for the removal of carbon. Price 75 cents.—Bigelow Co., Chicago, Ill.



Bigelow spark intensifier, with mounting

Haco Tire Lock

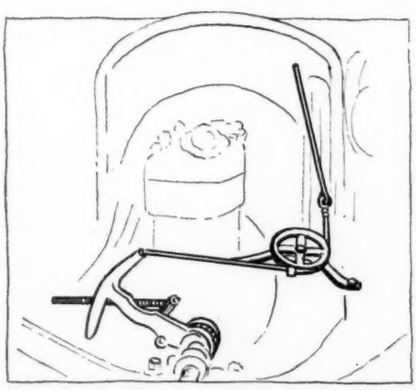
This lock fits 1916 Buicks, Maxwells, Chevrolets, Saxons and other cars using the same type of tire carrier. It is applied to the tire carrying rim and prevents the tire from being taken off until the padlock is unlocked and the stop removed. A Yale lock is fitted to the device. Price, $2.—Howard Automobile Co., San Francisco, Cal.



Haco tire lock

Brinnon Starter for Fords

Starting the motor by hand from the dash is accomplished by this device which consists of an arm which is connected to the front of the crankshaft by a ratchet, and from whence a cable runs to the handle mounted on the dash. Price, $10. —Peters Sales Co., Columbus, Ohio.



Brinnon hand starter for Fords

Arvac Universal Joint

As shown in the accompanying illustration of the Arvac propeller shaft assembly, the universal joints are fully inclosed so as to be dust, dirt and fool proof, the design being very compact, simple and accessible. The joint consists of a ball yoke in a socket fitted with cross block and pin, the housing being of forged steel and the entire joint easily disassembled. Bearing surfaces are as large as is consistent with maximum strength and minimum friction. The piece parts being standardized, the few wearing parts may be renewed promptly at minimum expense. The housing is oil-tight and is packed with lubricant, the yoke of the slip joint being made proof against grease leakage by a threaded steel cap containing a soft felt washer. The ample bearing surfaces are hardened and ground to size, thereby guaranteeing long life, minimum friction and uniform accuracy. The Arvac joint is made in one size only—5 in. diameter of flange. This is suitable for all types of passenger cars and trucks requiring a standard joint of this size. The propeller shaft assemblies are made with flanges bored to meet the customer's requirements and with suitable solid steel or hollow shafts. They may be obtained with or without companion flange and with square or 1½ in. ten spline S. A. E. slip fitting.—American Rotary Valve Co., Anderson, Ind.

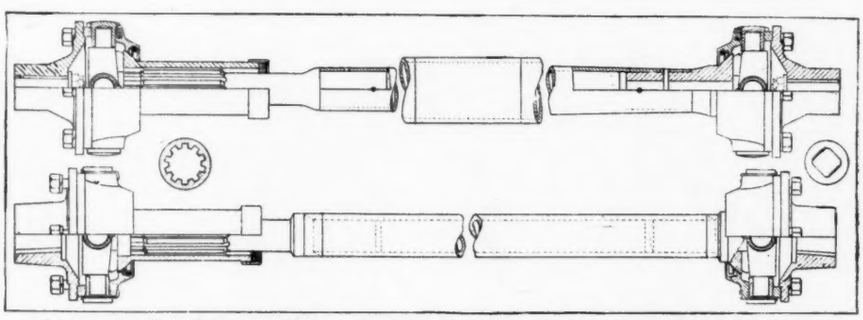
Frame Extension for Fords

The object of the extension is to lengthen the Ford wheelbase enough to permit the carrying of larger loads of bulky stuff. It is not intended that the normal carrying capacity, in pounds, should be exceeded.

The frame is extended at the rear by bolting on a new rear frame section, the forward end of which fits the curved cross-member, which takes the spring. The rear end of the extension is made exactly as the regular Ford frame rear end, and the spring is attached to it in the regular way, by the regular Ford clips. All the fastenings used are already provided for in the Ford frame and it is not necessary to do any cutting or drilling.

The propeller shaft is shifted backward when the rear axle is moved back to the rear end of the extension and leaves a gap between its forward end and the gearbox at the rear end of the power plant. This space is filled by inserting a tubular housing containing a short shaft with universal joint connections at each end, fitting the corresponding joint sections on the propeller shaft forward and on the driving shaft at the rear end of the gearbox. The casing bolts rigidly in place, the bolt holes already existing being used. The shaft and joints are packed in grease.

Material is furnished for lengthening the brake rods, and new running boards are supplied, of pressed steel. Every-



Arvac propeller shaft assemblies, showing compact, self-lubricating and fully inclosed universal joints

thing required to do the work is furnished; it is not necessary to purchase anything extra.

The outfits are furnished in two sizes; one increases the wheelbase 15 in., making it 115, and the other 30 in., making it 130. The weight of the car is increased about 50 lb.

Apart from enabling the car to carry a longer body, in which light but bulky loads can be carried—hats, bakery products, millinery, etc.—the appearance of the machine is greatly improved and its riding qualities as well. Extended tests have indicated that the added length is not sufficient to cause weakness of the frame even under the maximum normal load conditions and on rough going. This is due to the sturdiness of the Ford frame and also to the easier riding resulting from the longer distance between the axles. Prices, 15-in. extension, $45; 30-in., $50.—Hays Diefenderfer Co., New York City.

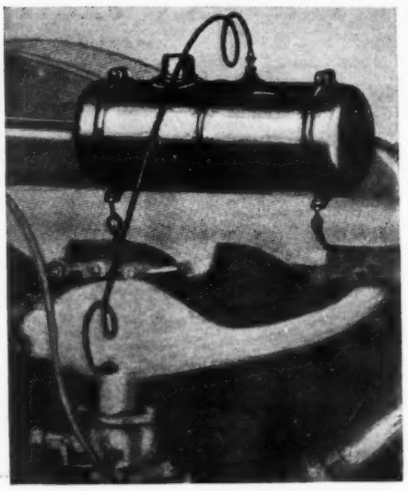
Weco Vaporizer

For the purpose of supplying a small quantity of water vapor, or steam, to the motor with the fuel mixture, a copper tank is mounted on the exhaust pipe, where the heat from the exhaust heats the water. A small tube leads the steam to the intake manifold above the carbureter. The tank holds 2½ qt. of water. Better vaporization, lower consumption of fuel and absence of carbon deposits are claimed to result from the use of the device.—Weco Mfg. Co., Boston, Mass.

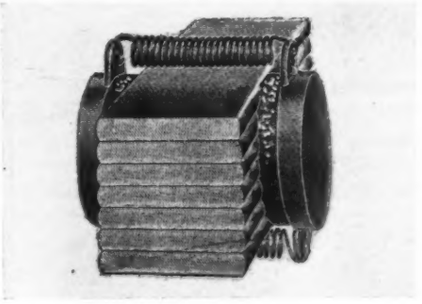
Temoc Specialties

A brush for washing the car may be attached to a hose and with it a car may be washed in 10 to 15 min. without wetting the hands or soiling the clothes. The brush is made of polished aluminum with Chinese bristles and is equipped with a mud scraper for removing chunks of mud from fenders, etc.

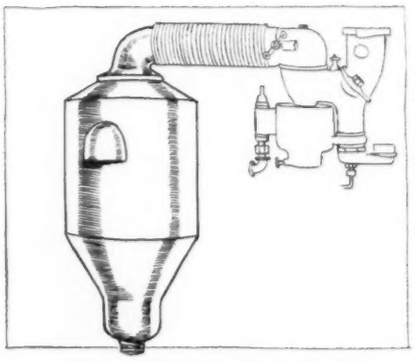
A spark plug brush is made of steel wire and is designed to remove carbon from plug points. It also embodies a screwdriver for adjusting the points, and an alligator wrench.



Weco water vaporizer which supplies steam with the fuel mixture



Sterling oiler applied to spring. Note the pads of oil-retaining fabric



Bennett carbureter air cleaner

A wire wheel washer is attached to the hose also. It is made of stiff bristles on flexible, rust-proof wire. Prices are: Washing brush, $3.50; spark plug brush, 40 cents; wire wheel cleaner, 75 cents.—Temoc Mfg. Co., Inc., Chicago, Ill.

Sterling Spring Oiler

This device consists of two shallow cups held one on each side of the leaf spring by means of spiral springs extending crosswise; in the cups, on the side next to the spring leaves, are pads of oil-retaining fabric. These distribute oil to the leaves and carry a sufficient supply for about a month's running. The pads are replenished without removing the oilers. Price, 40 cents.—Sterling Mfg. Co., Cleveland, Ohio.

Bennett Air Cleaner

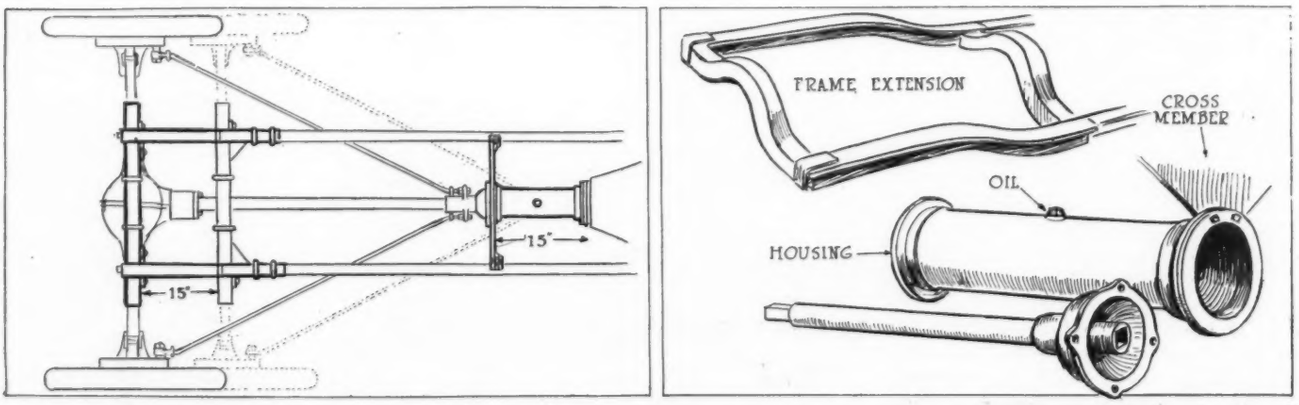
The object of this device is to remove from the air going to the carbureter all dust and other solid matter in suspension. Much of this matter is of an abrasive nature and has a deteriorating effect on bearing surfaces, and all of it is clogging to the oil used for lubrication. There are no moving parts and no cloths to clean, no screens and no adjustments. A cap is removed to empty out dust; otherwise the cleaner requires no attention. Prices, 1-1¼ in., $10; 1½-1¾ in., $11; 2-2½ in., $12.—Wilcox-Bennett Carbureter Co., Minneapolis, Minn.

Tenox Liquid Gasket

This liquid gasket is a new preparation designed to take the place of copper, asbestos, fiber, or other gasket materials. It is said to be suitable for all purposes and is not affected by heat, oil, water or gasoline. It is applied the same as paint, an ordinary brush being used.—Stone Mfg. Co., New York City.

Culver-Stearns Searchlight

In the description of the windshield type searchlight made by the Culver-Stearns Mfg. Co., Worcester, Mass., in THE AUTOMOBILE for April 20 the price as given is $2.25. This was an error, the correct price being $2.50.



Hayes-Diefenderfer frame extension for Fords. Left—Diagram showing method of extension. Right—Parts used in making change

The Automobile

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True Efficiency

EFFICIENCY is the watchword of the age. It is another word for civilization, for civilization is nothing but efficiency applied to life. The aim of every man and of every community is to make life as happy a thing as possible and civilization grows because of its efficiency in producing happiness. A savage may be happier than a civilized man, but America to-day is a far happier land than America of five centuries ago. Therefore it may be said truly that everything which improves efficiency in anything also advances civilization and makes for a better condition of living.

It is impossible to think about efficiency in some particular application without seeing the effect that one thing has upon another. Often obtaining more efficiency in one thing leads to a corresponding sacrifice in another; an apparent gain may be an actual loss in the final analysis. Particularly is this so in the highly specialized field of automobile engineering, and it is useful sometimes to examine the aims and ambitions of the automobile user and the automobile industry so far as possible in the light of true efficiency.

The basic thought, which should always be remembered, is that the automobile industry exists by reason of its service to civilization—exists and has grown with such wonderful rapidity because of the efficiency of the automobile as a servant of man.

The value of the automobile to the world was somewhat clouded by the unexpected pleasure-car growth, the efficiency of the truck and the tractor are obvious, but if we consider what the passenger car has done by improving means of communication, by educating the mind while exercising the body, it may well be wondered whether the greater good to civilization has not been done by the touring machine.

Races and Records

LAST year saw racing of a very high order of quality throughout the season. New speedways and new cars combined smashed records right and left. The average speed of racing increased largely, while the reliability of the better cars seemed unaffected by the greater pace. With the first big speedway event of the year about to take place the possible character of this year's racing becomes a topic. Shall we see still higher speeds or still greater durability?

So far we have no hint of the coming of any new team likely to stand out as did the unconquerable Stutzes last year. The two Sunbeams are the only new cars likely to come from Europe. That the Peugeots will show much more speed than last year is doubtful; the Delage team may be a surprise. They are certain to be at least as speedy as their French competitors and later there will probably be one or two new American teams.

Two things point to greater speeds in 1916 racing. One is the number of shorter races and the other the fact that tires to-day are better than they were a year ago. Average speed for the whole field in any event is sure to increase, because several cars that started new last year were only got into proper shape by the end of the season. Lessons on ignition, on carburetion and on lubrication, provided by every race in 1915 have not been overlooked and the cars to face the starter in the classics of 1917 will be the finest group ever gathered together.

Lubrication

IN Europe automobile engineers are still undecided as to the merits of different lubricating systems. While they usually prefer a fully forced scheme for engines but little below the racing type in volumetric efficiency there are many who consider a dipper system is the better for ordinary touring cars. There are many French and British chassis with small engines of high power output which use trough and dipper lubrication with complete success, and recent American developments have shown that the high speed motor does not have to have a pressure oil feed to every bearing.

Splash lubrication is, however, like many other things: it is good if carried out properly, but if designed indifferently, indifferent results are to be expected. Furthermore, exponents of well designed splash systems claim for them the greatest obtainable economy of oil, and this desirable feature is thrown away if the detail is not such as to insure the proper depth of dip all the time.

S. A. E. Aids Army on Trucks

Officials of Society Confer with Military Men on Revised Specifications

NEW YORK CITY, May 10—A conference was held at the rooms of the Society of Automobile Engineers this week with representatives of the United States Army on revised annual specifications for military trucks of 1½ tons' capacity. Lieut.-Col. Chauncey B. Baker of the Quartermaster Corps, U. S. A., addressed the meeting. William M. Britton, electrical and mechanical engineer of the War Department, was also present, together with other S. A. E. members convened for the purpose of conferring in an informal way on standard specifications as to quality of materials, interchangeability of parts, load capacity, road speed, location of control, ground clearance, engine capacity, suspension, electrical equipment and many other elements.

Henry Souther, past president of the society and now consulting engineer of the United States Signal Corps, presided at the meeting, the following being in attendance:

H. W. Alden, chief engineer, Timken Detroit Axle Co., Detroit, Mich.

Joseph A. Anglada, consulting engineer, New York City.

B. B. Bachman, engineer, Autocar Co., Ardmore, Pa.

Chauncey B. Baker, Quartermaster Corps, U. S. A., Washington, D. C.

P. J. F. Batenburg, chief engineer, Four Wheel Drive Co., Clintonville, Wis.

William M. Britton, electrical and mechanical engineer, Quartermaster Corps, War Department, Washington, D. C.

A. Ludlow Clayden, chairman standards committee, S. A. E., New York City.

Chester E. Clemens, mechanical engineer, Perfection Spring Co., Cleveland, Ohio.

H. D. Church, chief engineer truck division, Packard Motor Car Co., Detroit, Mich.

Coker F. Clarkson, general manager, S. A. E., New York City.

Howard E. Coffin, chairman Naval Consulting Board, Industrial Preparedness Committee, New York City.

Herbert Chase, chief engineer, Automobile Club of America, New York City.

D. L. Gallup, professor gas engineering and consulting engineer, Worcester Polytechnic Institute, Worcester, Mass.

R. H. Johnston, New York manager, the White Co.

Lewis P. Kalb, chief engineer, Kelly-Springfield Motor Truck Co.

J. A. Kraus, chief engineer, Garford Motor Truck Co., Lima, Ohio.

Robert McA. Lloyd, consulting engineer, New York City.

A. F. Masury, chief engineer, International Motor Co., New York City.

W. T. Norton, Jr., chief engineer and general superintendent, Selden Motor Vehicle Co., Rochester, N. Y.

H. W. Perry, secretary truck committee, National Automobile Chamber of Commerce, Inc., New York City.

Alfred Reeves, general manager, National Automobile Chamber of Commerce, Inc.

A. L. Riker, vice-president and chief engineer, Locomobile Co. of America, Bridgeport, Conn.

C. B. Rose, chief engineer, Velie Motor Vehicle Co., Moline, Ill.

Arthur J. Slade, consulting engineer, New York City.

G. W. Smith, chief engineer, Thos. B. Jeffery Co., Kenosha, Wis.

Henry Souther, consulting engineer, United States Signal Corps.

W. R. Strickland, chief engineer, Peerless Motor Car Co., Cleveland, Ohio.

F. A. Whitten, chief engineer, General Motors Truck Co., Pontiac, Mich.

John Younger, chief engineer motor truck department, Pierce-Arrow Motor Car Co., Buffalo, N. Y.

S. A. E. Military Standards

The meeting marks the beginning of the establishment of comprehensive S. A. E. military standards. Once the fundamental requirements for the service in mind become clear, any additional detail recommendations necessary can be formulated with due promptness. The work is of a very broad nature and must obviously be conducted carefully. The extremely hard conditions under which trucks operate at the front in time of war constitute a large study in themselves.

President Huff expressed the view that, in addition to the work of formulating ultimate standards, the society should, through what might be called exigent committee work, give all possible advice on specifications submitted to it. Accordingly a committee was appointed this week to take up with the government officials detail data considered pertinent to standard specifications for gasoline motor trucks of 1½ tons' capacity. This committee, which has already held one long session, is constituted as follows: Coker F. Clarkson, chairman; B. B. Bachman, H. D. Church, L. P. Kalb, William T. Norton, Jr., A. L. Riker, C. B. Rose, John Younger, G. W. Smith, W. R. Strickland and A. Ludlow Clayden.

Another meeting of this committee will be held on May 18, at which time further discussion had by correspondence between the members will be considered, together with special reports of the springs division and of the electrical equipment division of the society.

9000 Trucks Monthly for U. S.

Could Be Supplied by Makers if Pressed—Weight Limited to 5000 Lb.

WASHINGTON, D. C., May 6—The War Department has made some inquiry as to the number of motor trucks of suitable characteristics available in this country on short notice for use by the army. All the manufacturers in the country, about 200 in number, were approached and 113 responded.

3000 Trucks a Month

It was found that by throwing out motor trucks that are too light or too weak and those that are too heavy or cumbersome, it would be possible to obtain, according to representatives of the manufacturers, something more than 3000 trucks a month of a type that will conform in all main essentials to army needs. It also will be possible to obtain 6000 additional trucks a month of a type that nearly conforms to departmental specifications and that could be used in an emergency. In other words, if the situation were pressing, there would be available an output of 9000 trucks a month.

Weight Limit 5000 Lb.

The specifications, among other things, limit the weight to 5000 lb., for the reason that heavier trucks are apt to cut through the crust of roads or break through country bridges and give much trouble generally over such poor roads as are likely to be used.

—

Automobile Corps in Military Maneuvers in Mohawk Valley

UTICA, N. Y., May 5—War was declared in Utica for a day and military measures of defense worked out in the practice maneuvers of an automobile battalion, April 30. Under command of the officers of Company B of the First Infantry, New York National Guard, the automobile reserves dashed 22 miles through the Mohawk valley to afford emergency relief for the Remington Arms plant at Ilion, N. Y., and the factory of the Savage Arms Co., at Utica, reported besieged by imaginary enemies which the militia and motor reservists met and routed in a sham battle.

Sixteen Studebaker passenger cars and one repair car composed the motor equipment. An automobile reserve corps of twenty cars will probably be organized to participate in the maneuvers of this kind to be held May 21, at the Sheepshead Bay speedway.

A. C. A. Tests Aero Motor

Christofferson Aircraft Product Tested for Power, Economy and Endurance

NEW YORK CITY, May 10—A test has been made by the technical committee of the Automobile Club of America on the aeronautic motor made by the Christofferson Aircraft Mfg. Co., San Francisco, Cal. Two runs were made, one to secure data on horsepower, torque, fuel consumption and speed and the other to get a line on endurance. The endurance run extended to 7 hr. 18 min. when the motor stopped due to magneto trouble. During the interval one stop was made to replace a broken rocker arm. This was at 5 hr. and 40 min.

The information secured on the first test run showed that the motor which is a four-cycle valve-in-head 4¾ by 6-in. watercooled type with vertical cylinders, develops 96.5 hp. at 1199 r.p.m.; 113 hp. at 1390 r.p.m.; 130.9 hp. at 1655 r.p.m.; with fuel consumption at these speeds of 0.68, 0.68 and 0.64 lb. per brake horsepower hour. The weight of the motor including inlet manifold, one carbureter, two magnetos, water manifolds, water pumps, oil radiator, but not including exhaust pipes, propelled flange or flywheel, is 511.6 lb. The weight given includes a small quantity of oil which could not be readily drained from the motor.

The endurance run started at 1.39 p. m. with the intention of making an 8-hr. endurance test. The throttle was open wide and the speed maintained by load at an average of 1449 r.p.m. At 5.40 p. m., that is, 4 hr. and 1 min. after the motor had started, the rocker arm operating the exhaust valve of cylinder six was broken and the motor had to be shut down. At 6.40 p. m. the rocker arm had been replaced by a new one and the motor was again started. The time taken to make the replacement was 24 min. The motor then ran until 7.18, when it suddenly stopped and it was found that neither of the magnetos were operating, the one on the exhaust side had broken its armature while the other had developed troubles of an electrical nature. For about ½ hr. before the motor stopped it had been missing considerably, due to the failure of the magnetos. The test was then discontinued. At this time the motor had been running a total of 5 hr. and 15 min.

The average speed during this test was 1449 r.p.m. The average brake horsepower was 113.6. The average gasoline consumption was at the rate of 75.8 lb. per hr. or 12.4 U. S. gal. The gasoline had a specific gravity of 61 deg. Baumé and during the test 2.26 gal. of lubricating oil were used. The motor was started with 10 gal. of castor in its crankcase and as oil had to be added Mobiloil Arctic, Mobiloil B and Mobiloil B B was admitted to the crankcase. The quantity of water circulated was 210 lb. per minute at an average inlet temperature of 150 deg. and outlet of 168 or at a temperature variation of 18 deg. As 210 lb. of water was circulated per minute the heat energy carried off in the cooling water amounted to 3780 b.t.u. per minute.

The motor was not taken down after the test but except for the broken parts mentioned above seemed to be in good condition.

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Woods Has Gas-Electric Car

CHICAGO, ILL., May 10—Final announcement of the Woods dual-power gasoline-electric vehicle has been issued and shows the price to be $2,650, instead of $2,700, as stated in January, when the plans were first made public. The design is based upon the provision of a gasoline motor and an electric generator to provide current for an electric motor, either directly or through the medium of a storage battery. The gasoline motor is a four-cylinder design manufactured by the Woods factory. It is not a high-powered engine, but is sufficient to drive the vehicle economically, and in case additional power is desired the effort of the gasoline engine is supplemented by the electric motor.

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Now Zapon Leather Cloth Co.

NEW YORK CITY, May 8—The Boston Artificial Leather Co., this city, has changed its name to the Zapon Leather Cloth Co. This concern has been in the leather cloth business for more than twenty-five years. The original Boston Artificial Leather Co. was located in Boston, Mass. The main offices were removed to this city in 1899. The original plant in Massachusetts was later removed to Milburn, N. J., and in 1904 to Stamford, Conn., where it is to-day. This plant has just been rebuilt, work having been started on it about one year ago, the size being trebled what it was three years ago.

The large increase in automobile business necessitated an increase in capacity and a larger working force, which now amounts to 600 employees. The company does a large business with the automobile manufacturers in heavy seating material. No light weight goods are made.

The use of the word "Zapon" brings the Celluloid Zapon Co. and that company closer than ever before. These two concerns have for more than a generation been closely affiliated, having always been owned and operated by the same interests. There will be no change in personnel of officers or management.

Miller Rubber 66⅔% Dividend

Common Stockholders to Receive That Sum—To Retire Preferred

AKRON, OHIO, May 9—The directors of the Miller Rubber Co. have declared a stock dividend of 66 2/3 per cent on common and taken steps to retire the present preferred at an early date at 120. The present authorized and outstanding capitalization is $1,500,000 common and $500,000 preferred. It will be increased, subject to stockholders' approval, to $5,000,000, half common and half preferred. The new preferred will be offered at 105.

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Raymond and Whitney Resign from M. & A. M. Board

NEW YORK CITY, May 8—At a meeting of the board of directors of the Motor and Accessory Manufacturers held May 5 the resignations of H. E. Raymond and C. E. Whitney as board members, as well as members of several committees, were accepted. Raymond explained it was in line with his general policy of retirement, whereas business reasons necessitated Whitney's retirement. H. E. Raymond served the Motor and Accessory Manufacturers as president during the years 1909 and 1910, as vice-president during the years 1904 to 1908 inclusive, as a member of the board since the year 1904, in addition to membership on a great many committees. Whitney served as a board member during the years 1905 to 1916 inclusive, as well as a member of many important committees. W. O. Rutherford, general sales manager of the B. F. Goodrich Co., was elected to fill Raymond's unexpired term as a board member, as well as an executive committee member. The president also appointed him a member of the finance committee. Christian Girl was made a member of the show and allotment committee. The election of Whitney's successor was postponed. The Lumen Bearing Co., Buffalo, renewed its membership at this meeting.

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S. A. E. Reservations Going Fast

NEW YORK CITY, May 10—Although it is now more than a month before the start of the S. A. E. summer cruise on the steamship Noronic, there are very few accommodations left. The latest reports show that out of a possible accommodation of 558 there are now 528 engaged. This leaves only room for thirty. The cruise stars on Monday, June 12, from Detroit, and the route lies through the Great Lakes and Georgian Bay. The duration of the trip is four days.

Saxon Plans New Factory

Negotiates for Purchase of 38 Acres in Detroit—Present Quarters Outgrown

DETROIT, MICH., May 10—*Special telegram*—The Saxon Motor Co. is negotiating for the purchase of a tract of land on the Detroit Terminal Railway which comprises about 38 acres in the vicinity of Michigan Avenue. The Saxon company has outgrown its present quarters, and while no definite plans have yet been made as to size or form of structure it is proposed to erect a plant which will adequately take care of next year's production, and this will be added to from year to year as required.

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Saxon Opens Detroit Assembly Plant

DETROIT, MICH., May 8—The Saxon Motor Car Co. has opened a branch assembly plant at Franklin and Beubien Streets, which will be devoted to building six-cylinder roadsters. This factory building, containing 60,000 sq. ft. of floorspace has for the past few months been used by the factory as a service station, but owing to the increased demand for cars, it was necessary to install assembling machinery and turn it over to manufacturing.

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Haynes Production of Twelves Starts June 10

KOKOMO, IND., May 8—The Haynes Automobile Co. is completing the fifth addition to its plant within the present fiscal year. The new structure that is being completed at the present time, will house the production of the light twelve car. It is expected that the manufacture of the high power, light weight car will be under way by June 10.

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Allen Motor Shortens Working Day

FOSTORIA, OHIO, May 6—An 8-hr. working day has been voluntarily put in effect at the Bucyrus plant of the Allen Motor Co., this city, manufacturer of Allen cars.

This plant has been operating on a 10-hr. day basis, and the 2-hr. reduction with 10 hr. pay was announced by the company.

The Bucyrus plant of the Allen company, in which all motors are made for Allen cars, has been working 24 hr. a day for some time.

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Westinghouse Strike Ends

PITTSBURGH, PA., May 9—The strike of the 15,000 electrical workers and shell makers of the Westinghouse Electric & Manufacturing Co. ended this morning, and there was a rush of those who had been out to get back to their places.

Threats that they would not be re-employed unless they returned to work this morning broke the strike. President E. M. Herr had refused all the demands, which included an 8-hr. day. He told the strikers that unless they were at work this morning they would lose not only all chances to be employed by the company again, but would also lose all the benefits accruing to them under the company's compensation and pension system.

The strike began April 22 and the employees have lost $1,397,500 in wages.

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51,739 Fords in April

DETROIT, MICH., May 8—The Ford Motor Co.'s output for the month of April was 51,739 cars as compared to 46,510 in April, 1915. According to the figures given, the company has now turned out about 370,000 cars since last August.

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Record Shipment of Studebaker Cars

DETROIT, MICH., May 8—The biggest single day's shipment of Studebaker cars in the history of the Studebaker Corp. was made on April 29, the output being 490 automobiles, representing a value of approximately a half million dollars.

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600 War Truck Order for Pierce

BUFFALO, N. Y., May 5—The Pierce-Arrow Motor Car Co., this city, has received a rush order for 600 5-ton trucks for the French Government, valued at $3,000,000, the last shipment to go forth in June.

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First Stephens Car Made

FREEPORT, ILL., May 8—The first complete automobile turned out by the Moline Plow Co., Freeport, which has been forced to embark in this line, due to the decline in the demand for farm vehicles and buggies, was on exhibition this week. It is known as the Stephens, complimentary to a member of the firm by that name. The first car was a roadster and was purchased by a physician of Freeport. The Moline company has decided to make its own fenders, having ample facilities in the plow department and has received requests from other automobile companies to supply fenders for them also.

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Liberty Car Deliveries in July

DETROIT, MICH., May 9—Deliveries of the new Liberty motor cars, manufactured by the Liberty Motor Car Co., according to Percy Owen, president and general manager, will probably begin early in July.

Grant Will Move to Cleveland

7 Acres of Land Purchased—Plant to Have 124,000 Sq. Ft. of Space

CLEVELAND, OHIO, May 9—The Grant Motor Car Co., Findlay, Ohio, recently recapitalized at $4,000,000, will locate its plant in Cleveland, where it will build a plant and office building costing $200,000. A 7-acre parcel of land at Colt Road and Kirby Avenue, N. E., has been purchased for the erection of a plant containing 124,000 sq. ft. of floorspace. The plant is to be erected immediately. The structure, including a two-story office building, is required to be completed July 15.

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Jackson Concerns Shorten Working Hours

JACKSON, MICH., May 8—It has been announced by three manufacturing concerns here in the automobile field that the hours of labor are to be shortened. They are the Sparks-Withington Co., which will operate on a 9½-hr. working schedule instead of a 10-hr. working day, as heretofore, and will pay the same wages as before; the American Gear Co. after May 11 will give 10 hr. pay for 9 hr. work; the Argo Motor Co. will hereafter give 10 hr. pay for a 9-hr. day, and the workmen will be given the entire Saturday afternoon.

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Overland Completes Another Addition

TOLEDO, OHIO, May 8—The completion of another factory structure at the plant of the Willys-Overland Co. adds an additional 500,000 sq. ft. of floor space. The entire plant has an aggregate floor space of 4,486,680 sq. ft., or 103 acres.

Shipments at the present time are averaging almost 900 cars a day.

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Movies for Sparton Employees

JACKSON, MICH., May 8—After next week the management of the Sparton plant of the Sparks-Withington Co., this city, will provide a free moving picture entertainment daily for the employees of the company. The shows will take place during the noon hour. The pictures will be selected from the regular releases of the moving picture studios. Free pictures will be shown every Saturday afternoon in the dining room of the Sparton plant if the families of the workmen desire them.

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Packard Employees Win Promotion

DETROIT, MICH, May 8—A large number of former factory employees of the Packard Motor Car Co. have been promoted to positions in the engineering

department as the result of their study in the factory night school. A class of eighty has just completed the prescribed course in mathematics and mechanical drawing and has been presented certificates. The entire enrolment is more than 150.

These classes have no connection with the school for apprentices. The school work was greatly stimulated by the policy announced several months ago by Alvan Macauley, vice-president and general manager, that the Packard company wants its employees to become loyal Americans and that promotions to positions of responsibility and trust would be given only to employees so inclined. This announcement was followed by a general campaign among all employees, foreign born as well as native born, to help them become more efficient workmen and better citizens.

An additional class in English for foreign-born employees was started May 1.

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Pickens Succeeds Schwartz

WALTHAM, MASS., May 8—R. A. Pickens has become managing director of sales of the Metz Co., this city. He succeeds W. H. Schwartz, who resigned last week. Mr. Pickens was formerly sales manager of the Regal Shoe Co.; sales manager of the Emerson Shoe Co.; advertising manager of the American Motor Co. of Texas; and a merchandising man in the same company.

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Heartz Switches to Premier

DETROIT, MICH., May 4—Roy Heartz, promotion manager of the Hupp Motor Car Co., has resigned, having been appointed assistant sales manager of the Premier Motor Corp., Indianapolis.

Following the resignation of Mr. Heartz, James G. Roe, who has been doing special work in the sales department under Mr. Heartz, has taken charge of the promotion work and Arthur E. Dixon of the service department has taken Mr. Roe's position in the sales department.

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Sawyer Jackson Sales Manager

JACKSON, MICH., May 6—C. B. Sawyer, former secretary of the Detroit Board of Commerce and of the Williams Bros. Co. here, has been appointed sales manager of the Jackson Automobile Co.

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Young with Allen Advertising Staff

FOSTORIA, OHIO, May 6—T. L. Young, formerly with the Overland advertising department, is now with the Allen Motor Co., Fostoria, as assistant advertising manager.

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Pfau Advertising Manager

CINCINNATI, OHIO, May 4—A. B. Pfau has been appointed advertising manager of the automobile specialty department of the Pfau Mfg. Co., this city.

Freight Situation Improves

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Railroads Return Freight Cars to Manufacturing Territory — Relief in East

NEW YORK CITY, May 10—The car situation was reported somewhat better during the last two weeks, railroads having been responding to the efforts of the Traffic Department of the N. A. C. C. to have automobile cars returned from the West and South into the manufacturing territory. New automobile cars of eastern system roads have also been coming out of the shops in greater quantities. Railroad conditions in the East, while they are not normal, are reported showing a gradual improvement. Cars are moving more freely and embargoes are somewhat relaxed. Exports are still embargoed except on freight for which steamship bookings are assured in advance.

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Bruenauer Is Gurney Gen. Mgr.

DETROIT, MICH., May 3—O. Bruenauer, formerly western sales manager of the Gurney Ball Bearing Company, will assume duties as general sales manager of the company on June 1 at Jamestown, N. Y., where the factory is located. The service engineering department of the company, herteofore located here, will also be removed to Jamestown.

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Welborn Leaves Packard Co.

DETROIT, MICH., May 9—Earl Welborn, former assistant of Henry B. Joy, president of the Packard Motor Car Co., has resigned to become general manager of Isko, Inc., a new corporation which has taken over the old plant of the Grabowsky Power Wagon Co.

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Donahue Joins Liberty

DETROIT, MICH., May 6—R. W. Donahue, formerly connected with the Oakland Motor Co., Studebaker Corp. and Dodge Bros., has joined the sales department of the Liberty Motor Car Co.

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Freeman Resigns from Denby

DETROIT, MICH., May 9—L. C. Freeman, one of the incorporators and chief engineer of the Denby Motor Truck Co., has resigned his position, but will still retain his interest in the company.

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Sullivan Fisk Advertising Manager

CHICOPEE FALLS, MASS., May 6—The growth of the business of the Fisk Rubber Co., and with it the natural increasing of their advertising, has made necessary a revision of this department.

On June 1, G. L. Sullivan, who has been associated with Bromfield & Field, Inc., advertising agency, New York City, will become advertising manager of the company.

Miss M. G. Webber, who has supervised the Fisk advertising in the past and G. B. Hendrick, who has been in charge of publicity, will act as assistants to Mr. Sullivan.

Mr. Sullivan's initial advertising experience was with the Boston Woven Hose & Rubber Co. in the sale of Vim bicycle tires. Later he became advertising and special sales manager of the Daniels & Fisher Stores, of Denver, Col. His first advertising agency viewpoint came with the Cheltenham advertising agency.

His experience in the automobile industry specially fits him for the work with the Fisk Rubber Co. For three years he was with the American Locomotive Co.

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Mattison Is Engineering Products Mgr.

DETROIT, MICH., May 8—C. A. Mattison, former sales manager of the Detroit Engineering Products Co., manufacturer of Paramount interrupters and other devices, has been promoted to the position of general manager of the company, having assumed his new duties May 1.

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Whyte Joins Prest-O-Lite Staff

INDIANAPOLIS, IND., May 6—J. Whyte has become manager of the storage battery service department of the Prest-O-Lite Co., this city. He was formerly electrical engineer of the Maxwell Motor Co., Detroit, and was at one time assistant chief engineer for the Scripps-Booth Co., Detroit.

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Dupree Joins Caskey-Dupree

MARIETTA, OHIO, May 8—S. F. Dupree, Jr., formerly head of the Ford department of the Westinghouse Electric & Mfg. Co., Pittsburgh, Pa., has associated himself as vice-president in charge of sales and advertising of the Caskey-Dupree Mfg. Co., this city.

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Gates with Smith Form-a-Truck

LOS ANGELES, CAL, May 9—W. O. Gates, Los Angeles, has been appointed Pacific coast manager of the Smith Form-a-Truck Co., with headquarters in Los Angeles.

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New Mich. Stamping Building

DETROIT, MICH., May 8—The Michigan Stamping Co. will erect a new one-story building, 600 by 347 ft., on Mack Avenue near the Lozier plant.

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National Can to Build

DETROIT, MICH., May 8—The National Can Co., manufacturer of radiators, is to erect a three-story building, as an addition to the main plant.

Tractors Till 1 Acre to 2½ Gal. Gasoline in Illinois Corn Belt

Department of Agriculture Analyzes Data of Nearly 200 Users as to Sizes Preferred for a Good Acreage and as to the Work Accomplished by These Machines

WASHINGTON, D. C., May 6—Under the title of "An Economic Study of the Farm Tractor in the Corn Belt," the U. S. Department of Agriculture Farmers' Bulletin 719 summarizes the experience of nearly 200 farmers in using different sized tractors on farms of different acreage. The object of the bulletin is not to draw general conclusions from facts and figures, but to place before the farmer the experience of others and leave it to him to calculate the probable value of the tractor for use on his particular farm. Before citing the information, the investigators point out that data on the operation of tractors soon become obsolete because of the changes and improvements in these outfits as well as on account of change in prices and the cost of fuel and oil.

The figures cited in the bulletin, the authors believe, are correct for conditions that existed in the spring of 1916 on the farms in Illinois, and they believe that these figures should be applicable not only in that State but throughout the corn belt, since the Illinois farms reporting are quite typical in most respects of general conditions prevailing in the corn belt.

Corn Principal Crop

On practically all of the farms reporting, corn is the principal crop, approximately 40 per cent of the entire acreage being planted to that crop. Oats are raised in most cases with an acreage of about one-half as great as for corn. Wheat is raised to a limited extent on more than one-half of the farms. Hay, including alfalfa and clover, form a large percentage of the remaining crops. Both spring and fall plowing are practised. The land on these farms is mostly level or gently rolling and quite free from stone for the most part. While there is a good deal of rather heavy loam, the plowing conditions are not severe except in very dry weather. The fields commonly are regular in shape, ranging in size from about 20 acres up.

These conditions under which the tractors were used should be borne clearly in mind in considering the following summary of the principal facts brought out by a careful study of the experience of the farmers as stated in their reports. Moreover, it should be understood that the figures given represent average results obtained in actual service and not maximum possibilities of the tractor. These averages, however, are believed to be worth more to a farmer in determining the possible value of a tractor in his work than are maximum figures from tests which, no matter how carefully conducted, can represent only a limited number of machines and a limited variation in conditions.

2½ Gal. Gasoline per Acre

The summary averages a large number of favorable and unfavorable reports from both competent and incompetent operators. The reports include new tractors with new sharp plows and older tractors using plows that have been sharpened several times and are not in perfect adjustment. For this reason the average fuel consumption of 2½ gal. per acre from so many users possibly is a safer guide to the farmer than would be gasoline rates obtained under fairly ideal conditions.

Three Chief Advantages

The chief advantages of the tractor for farm work, in the opinion of the operators, are: 1, its ability to do the heavy work and do it rapidly, thus covering the desired acreage within the proper season; 2, the saving of man labor and the consequent doing away with some hired help; and, 3, the ability to plow to a good depth, especially in hot weather.

The chief disadvantages are difficulties of efficient operation and the packing of the soil when damp.

The purchase of a tractor seldom lowers the actual cost of operating a farm and its purchase must usually be justified by increased returns.

Suitable Sizes Needed

One of the most important points in connection with the purchase of a tractor is to obtain one of suitable size for the farm on which it is to be used. In this connection experienced tractor owners in Illinois make the following recommendations:

For farms of 200 crop acres or less, the three-plow tractor.

For farms of from 201 to 450 crop acres, the four-plow tractor with the three-plow outfit second choice.

For farms of from 451 to 750 crop acres, the four-plow tractor with the five and eight-plow outfits tied for second choice.

A farm of 140 acres is the smallest upon which the smallest tractor in common use, the two-plow outfit, may be expected to prove profitable.

Medium-priced tractors appear to have proved a profitable investment in a higher percentage of cases than any others.

The life of tractors, as estimated by their owners, varies from six seasons for the two-plow to ten and one-half seasons for the six-plow outfits.

The number of days a tractor is used each season varies from forty-nine for the two-plow to seventy for the six-plow machines.

No definite figures on the repair charges for late model tractors can be given; it would not seem safe, however, to count upon less than 4 per cent of the first cost annually, this representing the average for farm machinery in general.

Under favorable conditions a 14-in. plow drawn by a tractor covers about three acres in an ordinary working day. Under unfavorable conditions large gang plows will cover less ground per day per plow pulled than will the small ones.

Tractor Size and Fuel

Two and one-half gal. of gasoline and 1/5 gal. of lubricating oil are ordinarily required in actual practice to plow 1 acre of ground 7 in. deep. The size of the tractor has little influence on these quantities.

Plows drawn by tractors do somewhat better work, on the whole, than horse-drawn plows. In Illinois the depth plowed by tractors averages about 1½ in. greater than where horses are used.

Efficient operation is essential to success with a tractor, and proficiency usually can be obtained more cheaply and easily by previous study and training than by experimenting with one's own tractor.

With a proficient operator the tractor is a very reliable source of power.

The use of the tractor for custom work is usually an indication that the home farm is not large enough to utilize it economically. The doing of custom work with the tractor, on the whole, appears to be a questionable practice, although nearly 45 per cent of machines are used for such work to some extent.

Displaces 25 per Cent of Horses

A tractor displaces on an average about one-fourth of the horses on the farm where it is used.

On a large number of Illinois farms brood mares constituted 33 per cent of the work stock before the purchase of the tractor. The use of the tractor increased this proportion only 3 per cent.

Experienced tractor owners do not consider even a two-plow outfit profitable on a farm of less than 140 acres. The average size of farm on which two-plow outfits are used in Illinois is 270 acres.

The four-plow tractor is most recommended by experienced owners.

Both increases and decreases in the crop yields are reported from the use

of the tractor, although favorable effects are more common than unfavorable. However, increases are not sufficiently frequent to warrant a farmer placing much dependence on the tractor in this respect.

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Department Store Trucks a Feature of French Army

PARIS, April 28—Department store trucks, from which commodities are sold to troops along the front, are now an established feature of the French army. The high cost of living in France is most severely felt by men in the active army, for they are obliged to purchase at the few village stores open just behind the lines, and have to pay the fancy prices imposed on the plea of high freight, danger, and scarcity. It was in order to remedy this unsatisfactory condition that the military authorities fitted up a certain number of Peugeot 3½-ton trucks as general stores, and sent them out to travel among the various armies in the field. All kinds of necessary articles likely to be required by men in the field —candles, soap, shoelaces, towels, paper, ink, shirts, socks, brushes and simple medicaments — are to be found aboard the automobile stores and are sold at practically cost price. These trucks have definite routes through the small towns and villages in which troops are quartered during their rest periods from service in the trenches. At first adopted as an experiment, this service has proved an immense success and has been extended to the whole of the French army.

Recently the French authorities have decided to equip and send to the front a series of automobiles specially equipped for giving shower baths, hot baths, for disinfecting clothing, and for washing linen. These automobiles will operate just behind the French front, among soldiers relieved from the trenches and the troops held in reserve.

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F. W. D. Auto Co. Takes Over Four-Wheel Tractor?

CLINTONVILLE, WIS., May 6—It is reported on good authority that the Four Wheel Drive Auto Co., Clintonville, Wis., has taken over the Four Wheel Tractor Co., organized some time ago at Antigo, Wis., to manufacture a general utility machine employing the four-wheel-drive idea. The report says the entire business at Antigo will be moved to Clintonville at once and consolidated with the F. W. D. factory.

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Hunting in Cars Prohibited in New York

ALBANY, N. Y., May 5—Hunting in automobiles in New York State is barred according to a bill which has just been signed by Governor Whitman.

Metal Wheels Gain in Europe

Cast Steel Type Employed on Trucks—Disk Wheels Also Used

PARIS, April 28—The war has been responsible for the almost complete elimination of the wood artillery wheel. For truck service the cast-steel wheel is generally employed by the French and Italian armies. The British, while large users of cast-steel wheels, also employ a percentage of disk wheels. For automobile ambulance service and light trucks, particularly those with twin pneumatics at the rear, the steel disk wheel is in a decided majority. American trucks brought into Europe for army service are all fitted with wood artillery wheels. These are allowed to remain, but in most cases when renewals are necessary they are replaced by steel.

Fiat, one of the largest manufacturers in Europe, and certainly the largest in Italy, uses no wood wheels. Heavy trucks are fitted with cast-steel wheels, ambulances and light trucks on pneumatic tires with steel disk wheels, and lighter touring cars with Sankey steel wheels. Renault, the biggest manufacturer in France, has ceased to use wood for commercial vehicles, although employing it for touring cars.

Require No Attention

The advantage of the metal wheel over wood is that it requires no attention. This is particularly important in military service, where trucks have to do a very great variety of work. While some trucks may have to run daily on a fixed schedule, many others have to stand for weeks by the roadside fully loaded, probably with one pair of wheels exposed to the sun and the opposite pair in the shade. It has been found, too, that when a truck is set on fire it becomes a total loss if fitted with wood wheels, for the spokes burn out and it is impossible to tow the vehicle home. If fitted with metal wheels the truck can always be salvaged. In most cases a burned-out truck can be put into condition at comparatively small cost, provided it can be towed to the repair shop. As one of the constant aims of the enemy is to destroy automobile convoys, it is important that the wheels should be the least destructible portion of the vehicle.

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National Gas Engine Program

LAKEMONT, N. Y., May 10—William N. Hurley, vice-chairman of the Federal Trade Commission, and Dr. W. C. Huntington, commercial agent with the bureau of foreign and domestic relations, Washington, D. C., will be the speakers at the dinner of the National Gas Engine Assn. when the annual meeting is held in Chicago, June 27 to 29. A tentative program has been arranged by the secretary. A discussion of cost accounting will take up the afternoon session on the opening day, Chairman C. B. Segner to be in charge. The following papers will be read: Tractor Engines, W. J. McVicker; Tractor Design, William A. Horthy; Tractor Drawbar Ratings, Raymond Olney; Tractor Designing from the Automobile Designer's Viewpoint, William McGlashan; The Data Work, P. S. Rose; Ignition Selection, Harry G. Osburn: The Heavy Oil Engine, speaker announced later; Reducing Shop Costs, Theodore C. Menges; The Fuel Situation, E. E. Grant; Carburetion, E. E. Dean; Liquid Fuels, Present and Future, E. W. Roberts.

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Experimenting with Ford Tractors

DETROIT, MICH., May 8—The little plant at Dearborn where Ford tractors are being experimented with, and which is destined to be the nucleus around which a great industrial organization is very likely to be built, is now busily turning out fifty of the latest type of Ford tractors for experimental purposes. These will be put to work on Henry Ford's estate at Dearborn, and if they prove satisfactory they will very likely be the design eventually built in large numbers. The public, however, need not look for the tractor on the market for a long time yet.

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Tractor Demonstrations Without Medals

NEW YORK CITY, May 6—There will be no competing for medals by tractor manufacturers at the tractor farming demonstrations to be held this year in eight sections of the United States, under the auspices of the National Power Farming Committee. Nor will blue ribbons be awarded to the tractor which finishes its land first, or performs the most spectacular stunts.

Demonstrations will not be limited to plowing. Opportunities will be afforded to exhibit the work of disking, seeding, packing, manure spreading, and operating all other kinds of power equipment found on the average farm.

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Ordnance Co. Buys Sterling Motor

BROCTON, MASS., May 7—The Sterling Motor Car Co., this city, has been acquired by the Consolidated Ordnance Co., recently incorporated in Delaware to engage in various forms of ordnance manufacture. The deal includes the taking over of the list of contracts the Sterling company has for the manufacture of shrapnel adapters, also the orders on regular commercial business for automobile companies.

Good Outlook in K.C. Territory

Bankers Report Business Conditions Are Excellent—Car Dealers Increase Sales

KANSAS CITY, MO., May 6.—Bankers in Kansas City have declared recently that the prospects for business in this territory are the brightest they ever saw, with another good crop coming on top of those of the past year or so, and high prices generally sure. Their statements followed an especially favorable report on conditions by the Federal Reserve agent at Kansas City.

These statements have the support of figures of gains in the automobile and accessory business. One jobber said, for instance, that his trade had shown a gain of 54 per cent in the first three months of the year over the same months of 1915. This was E. J. Hess of the Equipment Co. "And April was even better, though we haven't figured the exact percentage," he added.

For some reason not explained some of the towns in the territory have not been sharing this advance. In the Wichita district it is reported that business has been good only since April 20, prior to that time dullness having prevailed throughout the winter. Wichita dealers fared fairly well, however, though they suffered also from the slump in trade, and especially from the slowness of collections until the past few weeks.

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Market Prices Steady

NEW YORK CITY, May 9—Market prices on automobile materials last week were steady with the usual fluctuations. Ceylon rubber continued its decline of the previous week when it dropped 2½ cents to 79. Yesterday it closed at 73 cents a pound. Para rubber is also quoting lower than last week, its lowest mark for the week being 67½ cents. Friday it rose to 69 and held at that price until the closing yesterday.

Lead has again dropped, this time 8 cents per 100 lb. to $7.30. Sulphuric acid has risen $1.00 to $3.00. These changes and the rubber situation were the features of the materials markets last week.

Rubber manufacturers are among those in the industrial field who are facing the problem presented by the high price of gasoline. Naphtha has been almost a necessity in rubber manufacture. The lines most dependent upon it are tire repair; dipped goods; tires and mechanical rubber goods. Wherever any union of parts is desired, naphtha is the usual agent to bring it about.

Gasoline is still quoting wholesale at from 20 to 24 cents a gallon. A rise is expected on account of the scarcity of crude oil. The present prices of crude oil are being watched eagerly by the gasoline interests as a rise in oil is expected to affect fuel prices in general.

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Gasoline Prices Unchanged

NEW YORK CITY, May 8—Automobile owners are still paying from 27 to 31 cents a gallon for gasoline in the East, the retailers taking a profit of from 3 to 7 cents, according to the location of the garage and the overhead expenses.

The price has remained stationary so long that the opinion is frequently expressed that a change must come soon. It is now fully two months since the advance stopped, while all the factors in the situation appear to point to a further rise. Activity in the oil fields has failed to uncover any large wells.

The Maxim Munitions Corp. has closed a contract for the exclusive manufacturing rights of Louis Enricht's substitute for gasoline.

The Maxim company is now making experiments to prove conclusively that this invention is practical for commercial purposes as a fuel. The corporation has bought near the property of the inventor an acre of land on which it will build its laboratory and factory.

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Another Fuel Substitute

BOSTON, MASS., May 8—Another man with a substitute for gasoline has made his appearance, this time at Stoneham, a suburb of Boston. His name is D. E. Smith, an attorney. While he claims to be the inventor, it is believed that a young fellow who has a reputation for experimenting in chemistry is the real inventor and Smith is representing him.

Last Saturday Mr. Smith went to Stoneham Square to the garage of D. G. Pratt, who handles the Maxwell line in the town, and said he wanted to prove that he had a gasoline substitute. Pratt allowed him to use one of his cars. In the presence of Mr. Pratt and some newspaper men the gasoline tank of the car was emptied.

The witnesses then certified to the conditions. Then Mr. Smith poured in a quart of colorless liquid from a glass milk bottle. The party of five then got into the car and it was started without trouble. A trip was made to Greenwood and back, maintaining a speed of from 20 to 25 miles an hour. Upgrades had no effect upon the fuel, which for lack of a better name Mr. Smith calls motive gas.

According to Mr. Smith, the chemicals are simple, and they are of American manufacture. They may be procured anywhere, and when mixed with water furnishes a fuel at 3 cents a gallon. He says all the operator of a car has to do is to fill the car with the mixture, and then by carrying a few bottles along and when the tank is empty pour in 5 gal. of water, empty the contents of a 6-oz. bottle in the water and continue on his journey.

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Goodyear to Increase to $25,000,000 Capital Stock

AKRON, OHIO, May 5—The Goodyear Tire & Rubber Co., Akron, has applied to the Secretary of State for permission to increase its authorized capital from $7,000,000 to $25,000,000. The increase is necessary to take care of the rapid expansion of the concern and the erection of additions to the plant.

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To Investigate Foreign Market Conditions

WASHINGTON, May 8—It will probably interest automobile manufacturers who are interested in foreign trade that the most extensive investigations into foreign market conditions ever undertaken at one time by the Bureau of Foreign and Domestic Commerce, Department of Commerce, will be under way soon after the beginning of the new fiscal year in July. These investigations will be aimed at the newer and more undeveloped markets lying well outside of the fighting zone, especially those in South America, China, India, Africa and Australia. Twelve different lines are to be investigated, and fifteen distinct examinations to find suitable agents for the

Daily Market Reports for the Past Week

Material	Tues.	Wed.	Thur.	Fri.	Sat.	Mon.	Week's Ch'ge
Aluminum	.58	.58	.58	.58	.58	.58	...
Antimony	.36	.36½	.36½	.36½	.36½	.36½	+.00½
Beams and Channels, 100 lb.	2.77	2.77	2.77	2.77	2.77	2.77	...
Bessemer Steel, ton	45.00	45.00	45.00	45.00	45.00	45.00	...
Copper, Elec., lb.	.29½	.29½	.29½	.29½	.29½	.29½	...
Copper, Lake, lb.	.29½	.29½	.29½	.29½	.29½	.29½	...
Cottonseed Oil, bbl.	10.75	10.73	10.93	10.90	11.00	10.98	+ .23
Fish Oil, Menhaden, Brown	.54	.54	.54	.54	.54	.54	...
Gasoline, Auto, bbl.	.24	.24	.24	.24	.24	.24	...
Lard Oil, prime	1.03	1.03	1.03	1.03	1.10	1.10	+ .07
Lead, 100 lb.	7.38	7.38	7.38	7.30	7.30	7.30	— .08
Linseed Oil	.76	.76	.76	.76	.76	.74	— .02
Open-Hearth Steel, ton	45.00	45.00	45.00	45.00	45.00	45.00	...
Petroleum, bbl., Kan., crude	1.55	1.55	1.55	1.55	1.55	1.55	...
Petroleum, bbl., Pa., crude	2.60	2.60	2.60	2.60	2.60	2.60	...
Rapeseed Oil, refined	1.05	1.05	1.05	1.05	1.05	1.05	...
Rubber, Fine Up-River, Para	.67½	.67½	.67½	.69	.69	.69	+ .01½
Rubber, Ceylon, First Latex	.76½	.73½	.73	.73	.73	.73	— .03½
Sulphuric Acid, 60 Baume	2.00	2.00	2.00	3.00	3.00	3.00	+1.00
Tin, 100 lb.	52.00	51.50	51.50	51.00	51.00	50.00	—2.00
Tire Scrap	.05⅞	.05¾	.05¾	.05¾	.05¼	.05¼	—.00⅛

work have been announced for some time in May.

For South America agents are being sought to study and report on markets for motor vehicles and other American productions. In the Far East, Africa and Australia a study will also be made of the markets for motor vehicles. One agent is also sought to look into possibilities for American commercial and industrial investments in South America and another to make a similar study in the Far East.

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New Financing for Perfection Spring

CLEVELAND, OHIO, May 5—Stockholders of the Perfection Spring Co., this city, have been notified that the company will issue treasury stock, $250,000 common and $250,000 7 per cent preferred. Arrangements have been made to sell the new preferred to a syndicate; the common is offered to shareholders at par, the entire offering being underwritten.

The company with these issues will have outstanding $1,000,000 preferred and $1,250,000 common, and will have all of its financing completed, having no obligations but current accounts.

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Advance-Rumely Re-elects Directors

SOUTH BEND, IND., May 8—At the annual meeting of the stockholders of the Advance-Rumely Co., Laporte, all members of the board of directors were re-elected as follows: F. P. Mount, Maurice Fox and William Taylor of Laporte; Elisha Walker, J. W. Platten and F. N. B. Close of New York; S. S. Strattan and Edgar Elliott of Chicago; B. T. Skinner of Battle Creek; H. H. Wehrhane and S. B. Fleming of New York.

Maxwell Features Securities

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Common Goes Up 5 Points on Dividend Rumors—Preferred Issues Higher

NEW YORK CITY, May 9—Rumors of mergers and dividend action were rampant last week and had their desired effect on security prices. Chevrolet, Studebaker and Maxwell shares advanced enthusiastically in the early trading on the Stock Exchange on Saturday on a report from Detroit which stated that there was in process of formation a huge merger embracing Chevrolet, General Motors, Maxwell, Continental, and Studebaker companies under the leadership of W. C. Durant, P. S. du Pont and L. G. Kaufman, with a capitalization of several hundred million dollars. While the rumor was subsequently denied by interests connected with the companies mentioned the result was a sensational rise in a few of the stocks.

On the curb Chevrolet sold up to 207, a new high record and an advance of 3 points over the old mark. On the Stock Exchange Maxwell common advanced to the new high price of 82⅜, a gain of 1½ points over the previous close and an advance of 9⅝ points over the low of Friday. Studebaker was another stock that made a considerable advance for the day, closing at 132¾, up 5½ points from the previous close.

Yesterday Maxwell common sold up to 86⅞ in anticipation of early dividend action on both that class of stock and and on the second preferred as well. It was among the most active stocks on the list, 34,500 shares changing hands. About 80 per cent of the convertible warrants issued last January, in payment of the 14¼ per cent back dividends on Maxwell first preferred stock at par, leaving about $350,000 outstanding. The wiping out of the accumulation of dividends on the first preferred opens the way for the placing of the $10,127,467 second preferred on its 6 per cent basis.

Notice has been sent to holders of Chevrolet motor stock that all restrictions as to sale of their stock received in exchange for General Motors common have been removed. An offer is made of $2 a share for an option good until Aug. 1 next to purchase all or any part of their holdings at $210 a share.

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Dividends Declared

Pratt & Whitney, quarterly of 1½ per cent on preferred, payable May 15.

Maxwell Motors quarterly of 1¾ per cent on first preferred.

Ajax Rubber Co., quarterly of $1.25 per share. Initial payment of $1.25 a share was made on March 15, payable June 15 to holders of record May 31.

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K. C. Tire Capital $575,000

KANSAS CITY, MO., May 6—The Kansas City Tire and Rubber Corp., this city, has been chartered with a capital of $575,000. Harry Goodman of Chicago is president, P. E. Werner of this city is vice-president, W. R. Swisler of Chicago secretary and L. J. Smith, this city, treasurer. The factory covers a 3½-acre tract at the northwest corner of Fourth Street and Central Avenue.

Automobile Securities Quotations on the New York and Detroit Exchanges

	1915 Bid	1915 Asked	1916 Bid	1916 Asked	Wk's Ch'ge
Ajax Rubber Co. (new)	..	..	65	67½	..
Aluminum Castings pfd	98	100	..	..	..
J. I. Case pfd	81	87	..	..	..
Chalmers Motor Co. com	93	96	150	158	—4
Chalmers Motor Co. pfd	94	98	89	99¼	—9½
Chevrolet Motor Co	..	..	205	207	—9
Electric Storage Battery Co	51	52	58	60	— ½
Firestone Tire & Rubber Co. com	485	..	820	850	+20
Firestone Tire & Rubber Co. pfd	110	112½	114	116	..
General Motors Co. com	138	140	425	440	—1
General Motors Co. pfd	97	99	119½	120½	+6
B. F. Goodrich Co. com	43	44	77	77½	+ ¾
B. F. Goodrich Co. pfd	101½	103	114	116	..
Goodyear Tire & Rubber Co. com	245	255	385	393	—20
Goodyear Tire & Rubber Co. pfd	105	106½	119	121	+2
Gray & Davis, Inc., pfd	..	..	..	..	..
International Motor Co. com	10	12	9	12	—1
International Motor Co. pfd	25	30	20	30	—2
Kelly-Springfield Tire Co. com	116	129	72½	73½	+1¼
Kelly-Springfield Tire Co. 1st pfd	83	86	96	98	..
Kelly-Springfield Tire Co. 2nd pfd	130	140	..	..	— ½
Maxwell Motor Co. com	46½	47½	82	82½	+5
Maxwell Motor Co. 1st pfd	81	83	86⅜	86⅝	+1⅜
Maxwell Motor Co. 2nd pfd	38	39	59¾	60¾	+2¾
Miller Rubber Co. com	180	188	255	270	—10
Miller Rubber Co. pfd	104	105	115	..	+1½
New Departure Mfg. Co. com	..	..	190	195	..
New Departure Mfg. Co. pfd	..	..	112	..	..
Packard Motor Car Co. com	105	..	165	175	..
Packard Motor Car Co. pfd	95	100	100	104	..
Paige-Detroit Motor Car	..	..	750	850	..
Peerless Motor & Truck Corp	..	..	23	25	+1
Portage Rubber Co. com	35	38	85	88	+10
Portage Rubber Co. pfd	85	88	107½	108½	— ½
Regal Motor Co. pfd	..	..	18	25	+3
*Reo Motor Truck Co	14½	16	28½	29¾	+1½
*Reo Motor Car Co	31	33	38¾	39½	+¼
Splitdorf Electric Co. pfd	..	..	..	..	..
Stewart-Warner Speed. Corp. com	68	69	85	87	+ ½
Stewart-Warner Speed. Corp. pfd	103	105	109	..	..
Studebaker Corp. com	66	67	132½	133½	+1½
Studebaker Corp. pfd	101	103	107	110	—1
Swinehart Tire & Rubber Co	80	90	83	84	—1
Texas Co.	129	131	190	192	+3
U. S. Rubber Co. com	60	62	53½	54½	—21½
U. S. Rubber Co. pfd	106	107½	109¼	110	+2¾
Vacuum Oil Co	213	215	237	240	—2
White Motor Co. (new)	..	..	49	51	+1
Willys-Overland Co. com	117	119	228	230	..
Willys-Overland Co. pfd	100	102	104	105	+1

*Par value $10.00.

OFFICIAL QUOTATIONS OF THE DETROIT STOCK EXCHANGE

ACTIVE STOCKS

	1915 Bid	1915 Asked	1916 Bid	1916 Asked	Wk's Ch'ge
Auto Body Co	..	..	31	..	..
Chalmers Motor Co. com	..	95	158	164	+3
Chalmers Motor Co. pfd	93	98	97½	101½	+1
Continental Motor Co. com	170	185	36	37¾	+ ¾
Continental Motor Co. pfd	82	85½	..	10¼	..
Ford Motor Co. of Canada	700	..	375	395	—5
General Motors Co. Com	136	144	400	430	—20
General Motors Co. pfd	98	100	116	120	+6¾
Maxwell Motor Co. com	45	49	83	87¼	+12¼
Maxwell Motor Co. 1st pfd	80	82½	85	89	+4
Maxwell Motor Co. 2nd pfd	36	38½	58½	61½	+4½
Packard Motor Car Co. com	103	..	166	..	..
Packard Motor Car Co. pfd	97	100½	..	104	..
Paige-Detroit Motor Car Co	..	..	840	875	+25
*Reo Motor Car Co	31	32¾	..	40	+ ⅝
*Reo Motor Truck Co	..	15¾	28¼	29	..
Studebaker Corp. pfd	100	102	107	..	..
Studebaker Corp. com	66	70	134	134¼	+3¼

INACTIVE STOCKS

*Atlas Drop Forge Co	..	26	..	40	..
Kelsey Wheel Co	195	..	320	365	..
*W. K. Prudden Co	19½	21	30	32½	..
Regal Motor Car Co. pfd	..	25	15	22	..

*Par value $10.

23 Sheepshead Bay Entries

Mulford Special Withdrawn—Will Probably Appear Later in Season

NEW YORK CITY, May 9—Up to date there are twenty-three entries for the Metropolitan trophy race to be held at Sheepshead Bay Speedway on May 13. The Mulford Special has been withdrawn due to motor trouble which could not be overcome in time to enter the race.

Four events will be held on the Sheepshead Bay track on that day. The feature event will be the Metropolitan Trophy, a 150-mile race for cars within the 300-cu. in. piston displacement limit. Entrants will be required to make 90 m.p.h. to qualify, and the race will be limited to 90 min. It is an A. A. A. championship award event under the new plan of the contest board of that organization for determining racing champions. The trophy will be contested for over three or five years. There will be $15,000 in prizes, distributed over seven places, varying from $6,000 for first to $400 for seventh.

The other events are: The 50-mile Queens Cup race, carrying $2,500 spread over five places, both being for cars within the 300-in. limit; the 20-mile Coney Island Cup, with $1,500 for five places, both being for cars within the 300-in. limit, and the 10-mile Brooklyn Handicap for non-winners, the prize being the William Kemble Cup and $1,000 in five prizes. Anyone not taking a prize in the previous events is entitled to compete in this race. These three cups are given outright to the winners.

Special trains will carry the sportsmen from Chicago, Boston, Baltimore and Washington, while thousands from all over the country will tour to the speedway in automobiles. Inquiries sent out by the speedway management to automobile clubs have resulted in excellent reports on road conditions. A personal inspection has been made and motorists advised as to the best route to take.

Some of the times which were snapped were Henderson in the Maxwell, who reeled off a lap in 1 min. 9 1/5 sec., which is a speed of 104 m.p.h. Resta was timed in 1 min. 12 2/5 sec., which is 99½ m.p.h. Jack Lecain was out with the Delage and Billy Chandler with his Crawford. Jules Devigne also had his Delage out and J. Christiaens made a lap at 100 m.p.h. in his new Sunbeam. It is expected that there will be a feature race between the twelve-cylinder Sunbeam owned by Adams Bros. and the Blitzen Benz owned by Harry S. Harkness. These are supposed to be the two fastest cars in the world.

H. S. Harkness has made an added entry of a Pusun which will be driven by Aldo Franchi, an Italian. This car is built from a Peugeot chassis, with a Sunbeam motor. In its initial tryout the car averaged 106 m.p.h. Entries are:

Car	Driver
Adams Special	George Adams
Erwin Forty	Grover C. Bergdoll
Erwin Forty	Eugene Stecher
Peugeot	Ralph Mulford
Peugeot	Dario Resta
Peugeot	John Aiken
Crawford	Billy Chandler
Crawford	Dave Lewis
Crawford	Unnamed
Duesenberg	Eddie O'Donnell
Duesenberg	C. T. Devlin
Maxwell	Pete Henderson
Maxwell	Eddie Rickenbacker
Delage	Carl Limberg
Delage	Jack Lecain
Delage	Devigne
Delage	Unnamed
Sunbeam Six	Joseph Christiaens
Sunbeam Six	Aldo Franchi
Sunbeam Six	Unnamed
Mulford Olsen Special	C. W. Thompson
J. J. R. Special	Bert Watson
Pusun	Aldo Franchi

Chevrolet Takes Gardena Race

GARDENA, CAL., May 6—George Hill, formerly Barney Oldfield's mechanic, won the Garden road race for cars of 231 cu. in. piston displacement and under in a Chevrolet here to-day, covering the 75 miles over the 2.2-mile course in 1:47:13. Robert Conner in a Ford Special was second, in 1:49:02. Dochterman in a Chevrolet was third and Bacon was fourth in a Fiat. The latter two were flagged as Conner finished, spectators crowding on the course to congratulate winners making it dangerous for the race to proceed. Stutzman in a Grant Six went out in the lead on the first lap and for eight laps had things his own way. He came to the pits for a tire change and, as he was using wooden wheels, lost almost a lap, Hill going into first, where he stayed until the finish. The Grant never got up into the lead again, going into the ditch in the eighteenth lap. Heacox, driving a Cadillac, went into the ditch with a broken steering knuckle in the twenty-ninth lap.

The Gardena race is to be an annual affair for 231-in. cars, to-day's event being held in connection with the annual Gardena Valley strawberry day fête.

Hyatt Branch Service Managers to Meet May 18-20

DETROIT, MICH., May 9—The managers of the service branches of the Hyatt Roller Bearing Co. will gather at the general sales offices in this city May 18-20 for their first annual convention. The business sessions will be devoted to talks by officers of the company and to conferences on engineering, sales and advertising matters.

Thomson Sheepshead Director

NEW YORK CITY, May 5—A. E. Thomson has been appointed managing director of the Sheepshead Bay Speedway. Everard Thompson will continue as general manager and vice-president.

30 Entries for Indianapolis

Elimination Trials Will Be Held May 26-27 — Three Crawfords Late Entrants

INDIANAPOLIS, IND., May 5—The entry list for the Indianapolis 300-mile race May 30 closed May 1 but the records were held open until all entries which were mailed on the last day were received. The final list shows thirty entries for the International sweepstakes. The late comers included the three Crawfords which Billy Chandler is building at Hagerstown, Md., and two entries to be known as the Erwin Specials. These are entered by Grover Bergdoll, the Philadelphia millionaire.

The entry of Tom Alley in an Ogren car raises the total number of entries to date to twenty-eight. The speedway officials admit they have two more entries which they will not make public at present and a possible third.

Ralph DePalma, winner of the 500-mile race at the Indianapolis speedway last year, has wired for permission to enter his Mercedes car, stating that he has sold this car to Frank P. Book, a wealthy young Detroiter, who has had some racing experience and wants to drive at Indianapolis. Book will drive a Cadillac in the Chicago amateur race. DePalma did not get his entry in before the opportunity closed at midnight, May 1, so consent in writing must be obtained from all the other entries.

Rigid Tests Provided

Rigid physical tests must be passed by all entrants. Following are but samples of a whole volume of rules that are necessary to regulate such an enormous undertaking as this race: Each car must show 80 miles an hour in an official speed trial of one lap of the track to be eligible. Speed trials will be held on May 26 and 27. Cars shall start in the order of the time they make in the official speed trials; the fastest car starting in first position, next the pole. The racing numbers will be assigned in the same manner, the fastest car receiving No. 1. In event of rain the race will be postponed until Wednesday, May 31, or some subsequent date. Any driver who in the opinion of the officials or speedway management does not show sufficient skill and judgment in the handling of his car to make him a safe factor in competition shall be barred from the track. Any driver who on the day of the race gives evidence of exhaustion or other physical incapacity, making him a potential danger to others on the course, may be barred from further competition. The status of his eyesight, heart action, blood pressure and general

condition must have been approved by the speedway surgeon at least five days before the contest. Steering wheel spiders other than steel or bronze will not be permitted. All chain-driven cars must be equipped with chain guards. All parts of cars, with respect to safety, shall be subject to the approval of the speedway technical committee.

The entries follow:

Car.	Driver.
Maxwell	Richenbacker
Maxwell	Henderson
Frontenac	Louis Chevrolet
Frontenac	Arthur Chevrolet
Frontenac	Gaston Chevrolet
Peugeot	Resta
Peugeot	Aitken
Peugeot	Merz
Peugeot	Mulford
Sunbeam	Christiaens
Sunbeam	
DuChesneau Special	DuChesneau
Cleveland Special	
Premier	Anderson
Premier	Rooney
Premier	Stillman
Duesenberg	O'Donnell
Duesenberg	D'Alene
Crawford	Chandler
Crawford	Lewis
Crawford	Johnson
Delage	Oldfield
Delage	LeCain
Delage	Limberg
Delage	
Erwin Forty	Bergdoll
Erwin Forty	Stecher
Ogren	Tom Alley
Duesenberg	Not named
Osteweg Special	Osteweg

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To Try for West-to-East Record in Cadillac Eight

LOS ANGELES, CAL., May 8—E. G. Baker and W. F. Sturm, both of Indianapolis, left here in a Cadillac Eight at midnight on the first leg of their 3375-mile trip across the United States. They will try to better the West-to-East record made by Baker in a Sutz last May, which is 11 days, 5 hr., 25 min.

Their route for the first 24 hr. lies through San Bernardino, Barstow, Needles, Kingman, Williams, Flagstaff and Albuquerque. The finish will be at New York.

In the route they have selected this year Baker and Sturm hope to cut down the mileage from that of last year by taking a more direct route. Last year's mileage was 3728.4, and touched Phoenix, El Paso, Plains, Kan., and Emporia, Kan. The mileage of the route which they hope to follow is as follows:

Los Angeles to San Bernardino	63
To Barstow	79
To Needles	165.8
To Kingman, Ariz	72
To Williams	138.5
To Flagstaff	34.8
To Albuquerque, N. M.	381
To Santa Fe	66
To Las Vegas	72.9
To Raton	136.6
To Trinidad, Col	25
To La Junta	94.2
To Syracuse, Kan	114
To Dodge City	104.8
To Hutchison	153
To Florence	121.7
To Kansas City, Mo	134.5
To Columbia	159
To St. Louis	140.7
To Greenville, Ill	52
To Dayton, Ohio, via Indianapolis	322.1
To Greensburg, Pa	303
To Philadelphia	275.8
To New York	103
	3,375.7

Omar Wins Kern Co. Race

Hughes Driving Makes 100 Miles at 61.6 m.p.h.—Good in Stutz Second

BAKERSFIELD, CAL., May 7—*Special Telegram*—Hughie Hughes in the Omar won the 100-mile track race staged by the Kern County Fair Association here to-day, taking the event at 61.6 m.p.h. He jumped into the lead in the first lap and held front position to the finish, with but one stop at the pit. The 100-mile ramble was made in 1 hr. 36 min. 8.4 sec. Frank Good in a Stutz won second money, at 61.18 m.p.h., covering the 100 miles in 1 hr. 38 min. 4.8 sec. Third money went to Clyde Rhodes, a local speed king, who drove his Studebaker Special to the tune of 60.9 m.p.h. The Studebaker made the course in 1 hr. 38 min. 30.6 sec. Frank Elliott, in the old Mercer Monk, which now is known as the Gordon Special, won fourth place at 60.4 m.p.h., with 1 hr. 39 min. 20.6 sec. charged up to him on the timer's sheet. Lou Gandy in a Gandy Special was running fifth and was flagged in the ninety-seventh lap. Debolt in the McKees Special went out in the thirty-third lap with a broken oil line and Ed Waterman in a Gandy Special went out with a burned-out bearing in the sixty-sixth lap after driving a wonderful race.

Narrow Escapes from Accidents

Frank Good had a narrow escape when he blew a tire on the backstretch just after coming out of the turn. Only the clever driving of the pilot saved the crew and car. As the tire blew the car leaped into the air in a cloud of smoke, and the ambulance started across the field, but a second later the car was seen flopping across the course like a wounded animal. Good mastered the machine and rolled into his pit for a tire change.

Hughes Has Trouble

Hughes had a narrow escape also in the eighty-first lap when Rhodes crowded him on the turn, and he fought for his life in the dust. Hughes was called into the pit by Fred Aubert, chairman of the technical committee, in the eighty-sixth lap to wire up a loose tie rod which had jarred loose and at this time Hughes filled up with gasoline and went on through the race with a leak in the gas tank which was expected to put him out before he was given the checkered flag. The course was well policed and it was the best managed race staged in southern California this season, although there were only 3000 spectators.

In the 25-mile light-car race, Walter Smith in a Maxwell won first money. His time was 28 min. 58.8 sec. Fred Dochterman in a Chevrolet was second. Ed. Gibson in a Studebaker went out with engine trouble in the twenty-first lap after leading for practically the entire race. Dominic Basse, who was to drive the Milac, was excused by Referee Bird when he reported that his car had been attached in Los Angeles.

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Des Moines Speedway Changes Hands

OMAHA, NEB., May 10—Henry Gering of this city has sold his interest in the Des Moines mile and a quarter speedway to a syndicate of Des Moines men, the deal representing $50,000. Samuel Orloff of Des Moines, who with Gering promoted the speedway, has also disposed of a $10,000 block of stock to the same syndicate. He retains the rest of his interest and will continue to act as secretary of the organization. Gering, retiring as president of the company, is succeeded by A. H. Banks, with C. C. Taft as vice-president.

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$1,000 Prize for 2-Mile Record on Chicago Speedway

CHICAGO, ILL., May 8—A cash prize of $1,000 has been announced to-day by the Speedway Park Association of Chicago to any driver who at the end of the season holds the world's 2-mile speedway record, providing this record is made on the Chicago speedway and in official time trials. The offer is open to any A. A. A. registered driver, whether American or foreign, and to any car of any displacement. The trials must be under the observation and rules of the American Automobile Association, upon whose certificates of performance the award will be made at the end of the season. This offer remains open until the close of the Chicago speedway season, Oct. 31. In the event that a record of 120 m.p.h. for one lap is made, $1,500 will be added to the prize. Any A. A. A. registered driver wishing to try for the record must give the Speedway Park Assn. ten days' notice and pay expenses of the trial, unless the driver is invited by the speedway to try for the record, in which case the expense will be borne by the speedway. It is intended to invite all of the more prominent drivers to try for the record.

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Amateur Drivers Make Fast Time

CHICAGO, ILL., May 8—Entrants in the non-professional drivers' invitation race May 20 made some very fast time in practice yesterday on the local speedway. F. C. Sawyer made the fastest lap in practice so far when he drove his Mercer roadster one lap of the 2-mile course in 1 min. 30 and 4/10 sec. This is close to 80 m.p.h. There were twelve owner drivers in yesterday's practice, and in addition a number of tradesmen and preliminary workouts for the proposed trade race, which may be staged on the day of the owner drivers' event.

Factory Miscellany

Wisconsin Plant News—The Racine Steel Casting Co., owned and operated by the Belle City Malleable Iron Co., Racine, Wis., is now operating its new plant, which will have a monthly capacity of 300 tons of electric steel castings and 500 tons of electric steel ingots, produced by a 3-ton Heroult electric furnace. The foundry is 80 by 322 ft. in size, and the center bay, 50 ft. wide, is commanded by a 7½-ton Pawling & Harnischfeger crane. The company will make a specialty of manufacturing alloy steels to specifications. The subsidiary, as well as the parent company, has a large clientele in the motor car and tractor industry.

The Werra Aluminum Co., Waukesha, which specializes in aluminum castings for motor builders, is contemplating the enlargement of its foundry, established three years ago in the former Wisconsin Central car shops. The present facilities are not adequate to handle the great volume of business on the books.

The Thurner Heat Treating Co., 126 Ferry Street, Milwaukee, is installing a small furnace for producing high-speed tool steel.

The Milwaukee Auto Engine & Supply Co., 841 Twenty-ninth Street, Milwaukee, is enlarging its hardening furnace capacity.

The Warner Mfg. Co., South Beloit, has been incorporated with a capital stock of $10,000 to manufacture the Warner "Auto-Trailer" recently described. At the head of the company is A. P. Warner. J. W. Menhall and A. B. Cadman of Beloit are associated with him. A large production of trailers is now being made in the spacious shops leased by the company and re-equipped.

The Falls Machine Co., Sheboygan Falls, a large manufacturer of motors for several leading motor car manufacturers, has taken occupancy of its new assembling and testing floor shop, measuring 40 by 250 ft., and is making other important improvements looking toward enlargement and efficiency. A new record in motor construction was established at the Falls plant several days ago, when a cylinder block was finished in 38 min. This compares very favorably with the average made for similar work at the Ford works in Detroit, where a block is finished in 45 min. The Falls record was established on a six-cylinder motor casting, while the Ford average is on a four-cylinder. The Sheboygan Falls concern is also establishing commercial records. While 1915 business aggregated more than $1,000,000, the volume of the first three months of 1916 was more than $500,000, and at this time the company has orders for future delivery amounting to $2.500,000. Nearly 400 persons are on the payroll.

Van on 24-Hr. Schedule—The Van Sicklen Speedometer Co. has started continuous production in the assembly and machine departments of its Elgin, Ill., factory. These portions of the plant are now operated 24 hr. per day.

Tire Plant for Farwell—The Western Tire & Garage Co., Farwell, Tex., will shortly open a plant for the manufacture of automobile tires and rubber accessories. The plant when opened will give employment to 500 men. The officers are: Judge J. D. Hamlin, president; C. A. Robeson, vice-president; M. M. Craig, secretary, and C. L. McCallan, treasurer.

Jackson Shaft to Double Output—The Jackson Motor Shaft Co., Jackson, Mich., will erect an addition in the eastern part of the city, which will be 24 by 100 ft., directly adjoining the present structure. The new machinery required will cost nearly $15,000 and give employment to about fifty men, making a total of 200. The new addition will increase the output about 50 per cent. Between 10,000 and 12,000 cam shafts per month will be turned out. July 1 the plant will be taken over by the Briscoe Motor Corp., at which time the concern will be reorganized and the name of the firm changed, but the management as it now is will continue and the manufacture will go on as before.

The Automobile Calendar

ASSOCIATIONS

May 9-12—Hot Springs, Va., N. A. A. A. J. Meeting.
May 18—S. A. E. New York Section, May Meeting.
May 22-26—Chicago, Ill., N. E. L. A. Convention, Electric Veh. Section, Congress Hotel.
May 26-27—Del Monte, Cal., Meeting, Three Divisions of National Assn. of Automobile Accessory Jobbers.
June 12-16—S. A. E. Summer Trip on Great Lakes.
July 2-6—Detroit, Mich., World's Salesmanship Congress, Detroit Board of Commerce Bldg.

CONTESTS

May 13—New York City, Sheepshead Bay Speedway Race. Metropolitan Trophy, 150 miles; Queens Cup, 50 miles; Coney Island Cup, 20 miles, and Brooklyn handicap for non-winners, 10 miles.
May 20—Chicago Non-Professional Speedway Race, Western Interclub Speedway Park.
May 30—Des Moines, Iowa, Iowa Derby, 20 miles; Des Moines Special, 10 miles.
May 30—Tacoma, Wash., 10, 20, and 30-Mile Races, Tacoma Speedway Assn.
May 30—Elmira, N. Y., Track Race, Elmira Auto & Motorcycle Racing Assn.
May 30—Indianapolis Speedway 300-Mile Race.
May 30 — Minneapolis, Minn., Speedway Race.
June 4—Sheepshead Bay Speedway, 30-mile Race, American Liberty Day Committee.
June 10 — Chicago Speedway Race. International 300-Mile Race, Speedway Park, Speedway Park Assn.
June 16-17 — Sheepshead Bay Speedway, 24-Hr. Race, Trade Racing Assn., New York City.
June 20—Galesburg, Ill., Track Race, 100 miles.
June 28—Des Moines, Iowa, Speedway Free-for-All, 300 Mile Race.
July—LaGrande, Ore., Track Race, LaGrande Motor Club.
July 4—Coeur d'Alene, Idaho, Race Meet, Hillier-Riegel Co.
July 4—Tacoma, Wash, Speedway Race, Tacoma Speedway Assn.
July 4—Minneapolis 300-Mile Speedway Race.
July 4—Sioux City Speedway Race.
July 15—Omaha, Neb., Speedway Race.
July 15—North Yakima, Wash., Track Race, Hillier-Riegel Co.
Aug. 5—Tacoma Speedway Race, Tacoma Speedway Assn.
Aug. 11-12—Pikes Peak, Col., Hill Climb, Pikes Peak Auto Highway Co.
Aug. 12—Portland, Ore., Track Race, Hillier-Riegel Co.
Aug. 18-19—Elgin Road Race, Chicago Auto Club.
Sept. 4—Des Moines Speedway Invitation Race. Limited to six entries.
Sept. 4—Indianapolis Speedway Race.
Sept. 4-5 — Spokane, Wash., Track Race, Inland Auto Assn.
Sept. 16—Providence Speedway Race.
Sept. 29—Trenton, N. J., Inter-State Fair. H. P. Murphy, Racing Sec.
Sept. 30 — New York City, Sheepshead Bay Speedway Race.
Oct. 7—Philadelphia Speedway Race.
Oct. 7—Omaha Speedway Race.
Oct. 14—Chicago Speedway Race.
Oct. 19—Indianapolis, Ind., Race, Indianapolis Motor Speedway.
Nov.—Santa Monica, Cal., Vanderbilt Cup and Grand Prix Races.

GOOD ROADS

May 14-20—Milwaukee, Wis., Sheridan Road Week to Complete Highway Connecting Milwaukee and Chicago.
May 25—Pennsylvania's Second Good Roads Day.
Sept. 6-7—St. Paul, Minn., Good Roads Congress, Auditorium.

MISCELLANEOUS

June 8—New York City, Orphans' Day Outing at Donnelly's Grove, College Point, L. I. Orphans' Automobile Day Outing Assn.

SHOWS

Sept. 2-9—Columbus, Ohio, Fall Show, Ohio State Fair, Columbus Automobile Show Co.

TRACTOR

July 17-21—Dallas, Tex., Tractor Demonstration.
July 24-28—Hutchinson, Kan., Tractor Demonstration.
July 31-Aug. 4—St. Louis, Mo., Tractor Demonstration.
Aug. 7-11—Fremont, Neb., Tractor Demonstration.
Aug. 14-18—Cedar Rapids, Iowa, Tractor Demonstration.
Aug. 21-25—Bloomington, Ill., Tractor Demonstration.
Aug. 28-Sept. 1—Indiana Tractor Demonstration.
Sept. 4-8—Madison, Wis., Tractor Demonstration.
Sept. 11-16—Milwaukee, Wis., Fall Show, Wisconsin State Fair, Milwaukee Automobile Dealers.

The Week in the Industry

Columbus News Notes—A new Westinghouse service station has been opened by Thane C. Hecox, under the name of the Auto Electrical Supply Co., at 269 North Fourth Street. The concern carries a full line of auto and electric accessories.

John Hoffman, 2522 North High Street, has taken the central Ohio agency for the Case.

Northwest News—The Roesch Motor Car Co., Seattle distributor of Velie cars, has secured new quarters in the Queen City at 1109 Pine Street. A new service department has been added by this company.

The Ahlberg Bearing Co. has opened a northern office in Portland, Ore. C. J. Bender is secretary and B. H. Bodley has been named Portland manager.

The Foster-Larson Co., Spokane, Wash., has opened a sub-agency in Walla Walla, Wash., which will handle the Paige and National automobiles and Stewart and Garford trucks. S. A. Heist is the new manager in the Walla Walla territory.

New England Trade Items—G. S. Bishop, who has the Premier and Westcott cars at Boston, Mass., has added the H. A. L. to his line.

F. H. Grow, manager of the Langham Motor Co., Boston, Mass., has taken on the Davis car, his territory extending from Boston to Portland, Me.

F. A. Dutton, who has the Empire for New England, has placed an agency at Waterville, Me., with R. C. Whitney.

L. A. Vanchon, Brookline, Mass., has taken on the Overland for that town.

Earl Davis, who has been a special factory representative for the Paige-Detroit, has gone to Providence, R. I., to take charge of the Paige service department.

Large Spark Plug Order—The Beckley-Ralston Co., Chicago, Ill., has ordered 300,000 A.C. spark plugs.

New Bosch Contracts—The Bosch Magneto Co., New York City, has signed contracts with six concerns to use its magnetos for the coming season. They are the Roberts Motor Co., Sandusky, Ohio; Henderson Bros., North Cambridge, Mass.; Jordan Motor Car Co., Cleveland, Ohio; Republic Motor Truck Co., Alma, Mich.; Nordyke & Marmon Co., Indianapolis, Ind., and the Ogren Motor Works, Chicago, Ill. The contracts of the two concerns last mentioned also include complete lighting and starting equipment.

Trade Happenings

Hanks Goes to Chicago—M. W. Hanks, who is in charge of the Western sales of the automobile equipment department of the Westinghouse Electric & Mfg. Co., now has his headquarters in Chicago. Mr. Hanks was formerly located in the sales service station of the company at Indianapolis. Service work at Indianapolis is now handled by the Kelly-Springfield Co. of Ind., and the sales of the Westinghouse automobile equipment in this district by H. H. Johnson.

Ritchie Transferred—R. C. Ritchie, formerly in charge of the office of the Automobile Equipment sales service station of the Westinghouse Electric & Mfg. Co. in Chicago, has been transferred to the main office at Shadyside Works, Pittsburgh, Pa.

Seaman Knight Tire Representative—L. I. Seaman, formerly with the Ajax Tire Co., has been appointed district representative of the Knight Tire Co. for western and northern New York.

Higgins Burd Ring Factory Manager—G. H. Higgins has been appointed factory manager of the Burd High Compression Ring Co., Rockford, Ill.

Service Station for New York Metz—Robert Lurie & Co., Eastern agent for the Metz, leased two buildings at 307 and 309 West Sixty-seventh Street, New York City, for a service station.

Graham to Manage Goodrich Plant—L. K. Graham will manage a branch factory to be established by the B. F. Goodrich Co., Akron, Ohio, in El Paso, Tex.

Austin Cleveland Saxon Sales Manager—L. A. Austin has been appointed retail sales manager of the Loveland Co., Cleveland Saxon distributor.

Ahlberg Opens New Factory Branches—The Ahlberg Bearing Co., Chicago, Ill., has opened two new factory branches at San Francisco, Cal., and Portland, Ore., completing a chain of eleven branches at New York City, Boston, Detroit, Cleveland, Minneapolis, St. Louis, Portland, Atlanta, Los Angeles, San Francisco and Chicago.

Mountain Retail—Tom Botterill, East Thirteenth Avenue and Broadway, Denver, Pierce and Hudson distributor for Colorado, Wyoming and Utah, and Dodge dealer for Denver, has added to his salesroom and garage a $12,000 building, for adjustments and quick repairs, on an adjacent site directly across the alley. The new service building is 50 by 125 ft., faces on Thirteenth Avenue and also Lincoln Street, thus extending the Botterill business place the entire width of the block from Broadway to Lincoln Street.

The Mitchell Tire Co., a new concern formed by C. E. Mitchell and F. W. Graham, has opened a Defiance and Midgley Wire Tread Tire agency at 1622 Court Place, Denver.

W. G. Dickey, 1441 Wazee Street, Denver, Monogram Oil distributor for Colorado, Wyoming, New Mexico, Nebraska, Kansas, Oklahoma and Western Missouri, has opened a warehouse and branch office at Kansas City.

The Roberts Auto Co., 1618 Court Place, Denver, Marmon distributor for Colorado and Wyoming and Stevens-Duryea service station, is moving into a remodeled garage building at 220 Sixteenth Street.

The Downey Garage, 3312 East Colfax Avenue, Denver, has been appointed official service station for the Chalmers and Hupmobile and has bought a Chalmers demonstrator for agency use.

The National Motor Co., 1616 Broadway, Denver, National distributor for Colorado and Wyoming, has taken the Elgin distributing agency for the same territory.

The White Automobile Co., Perry A. Mead, manager, Denver agent for the White, has moved into new quarters in a $12,000 building at 1330 Broadway, with 50 by 125 ft. of floor space for salesroom and garage.

D. M. Gillespie, district sales manager for the White in the Rocky Mountain district, has moved his Denver headquarters from 424 Broadway to the new local agency building of the White Automobile Co. at 1330 Broadway.

The Chandler Motor Co. of Colorado, 1518 Broadway, Denver, Chandler distributor for Colorado and Wyoming, has taken the Denver agency for the Stutz.

The Headington Auto Co., 1636 Broadway, Denver, Metz, Enger and H. A. Lozier distributor for Colorado and Wyoming, has secured the distributing agency for the same territory on the Inter-State.

The Stutz Motor Sales Co., Greeley, Col., is the name of a new Stutz distributing agency for Colorado and Wyoming, managed by C. T. Ahlstrand.

Harold Beggs, formerly of the Boss Rubber Co., Denver, has opened a local agency at Pueblo, Col., for Knight and Blackstone tires exclusively.

Omaha Trade Items—The Overland Stores have bought a large block of property in the heart of Omaha's growing business section, the deal representing $55,800 in sales and $12,000 in leases. It is planned to hold the property as an investment until the company shall decide to build.

The Briscoe Nebraska Car Co. is being organized in Omaha, with A. Koppenhaver of this city as probable president. The concern will handle the Briscoe car in this territory.

The Foshier-Enger Co., Omaha, has moved its distributing agency and salesrooms from 1122-1124 Farnam Street to more commodious quarters at 2211-2213 Farnam Street, among its old associates along Auto Row. The firm handles the Enger and Dort cars.

The C. W. Francis Auto Co., Omaha, has enlarged and remodeled its space in the building at 2218 Farnam Street and now presents one of the most attractive interiors in the city.

Northwest News—One of the most important transactions in the commercial vehicle line ever made in the Pacific Northwest was recently consummated between the Northwest Buick Co. and W. H. Barnes, factory representative of the General Motors Co., whereby the Buick company will handle the entire truck line of the G. M. C. people throughout their territory, covering the States of Oregon, Washington, Idaho, British Columbia and Alaska.

Additional space has been added to the Seattle plant of the Northwest Buick Co. and particular attention will be given to the supplying of parts, the extension of service and the general welfare of the truck owners.

Will O. McKay has resigned as manager of the Newton Foster Co., Seattle, distributor of the Paige, Saxon, National and Garford truck lines. Mr. Foster has assumed the management of the business.

The Northwest branch of the Metz Co., under the management of J. P. Scearce, is now located in its new home at 1016 Pike Street.

The selling privileges on the Chevrolet line for Portland, Ore., and Multnomah county have been acquired by the Benj. E. Boone Co.

Thirty-three new Willard service stations were established by J. P. Schiller, Jr., district supervisor of the Willard Storage Battery Co. in the Pacific Northwest. There are now forty-six Willard stations in the territory, comprising Idaho, Montana, Oregon, Washington and western Canada.

The Oakland agency of Everett, Wash., has moved to its new building on Rucker Avenue.

Barnes and Beidler of Seattle, Wash., have taken the agency for the Vim delivery truck and opened salesrooms at Broadway and Pine Street.

The Simmons Co., Kenosha, the largest manufacturer of metal beds and springs in the world, which produces a large part of the spring sets used in motor car upholstery in this country, has purchased its largest competitor, the Rudgear-Merle Co., San Francisco, at a price said to be in excess of $2,000,000. The Pacific Coast plant will be enlarged at once and $100,000 will be expended for new machinery alone. Andrew Rudgear, president of the San Francisco concern, becomes a vice-president of the Kenosha company, in charge of the western division. L. C. Lance, formerly western manager for the Simmons Company, is made treasurer of the division.

Conn. Trade News—The White Motors Co., New Haven, has opened a branch in Hartford, at 45 Gold Street, under the managership of S. A. Foster, who has represented in Hartford and surrounding territory White automobiles during the past five years. A service station will be located temporarily at 22 Chapel Street. Next autumn it is the intention of the White Motors Co. to have a complete salesroom and service station under one roof.

A real estate deal involving $39,500 was consummated at Hartford this week when the Willys-Overland Co., Toledo, acquired a tract of land at the corner of Asylum and Hurlburt streets, on which will be erected a three-story concrete and steel service station and salesroom. The building will be 90 ft. on Hurlburt Street and 130 ft. on Asylum Street. There will be two levels, that from Hurlburt Street leading to the first floor or service station and that on Asylum Street to the salesroom. The building is to be ready for occupancy July 1.

Ill. Trade Items—M. S. Steele, formerly stationed in the home offices of the Moline, Ill., Plow Co., and later resident manager of the Henney Buggy Co. and the Freeport Carriage Co., both of Freeport, Ill., has been appointed Chicago sales manager for the Stephens Six, the automobile that is now being manufactured in Freeport by the Moline Plow Co., having recently added this line to the manufacture of plows and horse propelled vehicles.

The Castendyck-Hamel Co., Elgin, has outgrown its present quarters and is remodeling the building at 326 Third Street, that city, for a modern garage. In addition to a repair and storage business the firm will maintain a sales agency and carry supplies and accessories. The new building will be ready for occupancy by June 1.

The Charles Bradley Co., Springfield, Ill., has been organized and will open a salesroom and service station at 326-328 South Sixth Street about May 15. The company will be distributors for the Cole car.

The O. A. Zarth Wire Wheel Co., Aurora, located at 99 South Water Street, is now seeking larger quarters, having just secured an order from the Cole company of Indianapolis for 100,000 sets, and many other smaller orders. The Zarth wheel has several new features, particularly the method of attaching the spokes to the rim, and the lock which holds the removable wheel to the axle. The spokes are screwed into the rim, a new departure, which is said to make the joint permanent.

The new owners of the Stover Mfg. & Engine Co., Freeport, engaged in the manufacture of tractors and farm vehicles, made a thorough inspection this week of the property which came into their possession by reorganization and consolidation. The party included directors, investors and experts engaged to outline a plan of efficiency. Following the inspection the directors met and elected the following officers: President, W. A. Hance; first vice-president, J. F. Smith; second vice-president, H. H. Antrim; secretary, J. F. Smith; assistant secretary, R. H. Hubbart; treasurer, W. A. Hance; assistant treasurer, H. H. Antrim.

The Henton-Roberts Sales Co., Decatur, has opened an agency for the Enger and Argo cars at 252 East Main Street.

The Fisk Rubber Co. opened a branch at 434 Maine Street, Quincy, this week with A. R. Forse in charge as manager. A line of general supplies will be carried in addition to tires, and a complete repair shop for tires will be operated.

H. M. Wakelin, Melvin, has purchased the C. A. Platz garage. He will enlarge the plant.

A. F. Bloomfield of Indianapolis, and L. Saazer of Milwaukee, opened an automobile and commercial car body factory in the building in Streator, Ill., formerly occupied by the Central Garage at 125 South Park Street. Suitable machinery has been installed and a specialty will be made of woodwork for all makes of pleasure and commercial cars.

The King garage, Quincy, Ill., has been opened at 215 South Fourth Street by J. B. Thomas and B. F. Thomas. These quarters are but temporary, however, as a larger building is being sought in which show rooms can be arranged. A repair shop will be operated and a complete line of supplies and accessories will be carried.

Donald S. Hubbell, Elgin, Ill., has let the contract for a fireproof garage at 162 Douglas Avenue which will be 126 by 48 and two stories in height. The Ford agency will be housed in this building and a line of supplies and accessories will be carried and a general repair business conducted.